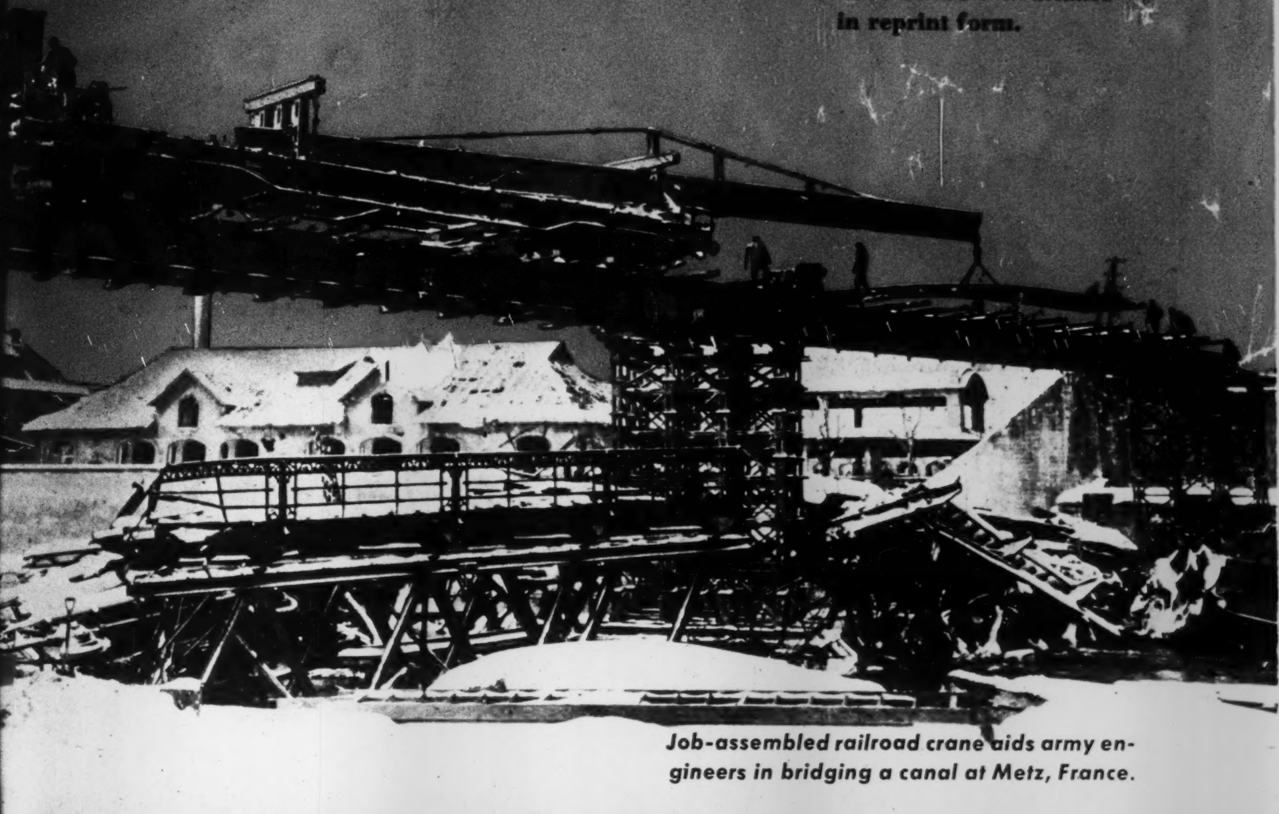
ENGINEERING NEWS-RECORD

JULY 26, 1945

RAILROAD BRIDGING IN THE E.T.O.

Last of 18 articles covering American Military Engineering in Europe by Waldo G. Bowman. This series is now available in reprint form.



Job-assembled railroad crane aids army engineers in bridging a canal at Metz, France.

Featured Also

EDGES BUILD A SWAMP ROAD   WINTER CONCRETING AT THE SOO

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WALDO G. BOWMAN, *Editor* ALBERT E. PAXTON, *Publisher*

Vol. 135 JULY 26, 1945 No. 4

COMING NEXT

- Repair of a collapsed brick trunk-sewer at Syracuse, N. Y., required an emergency operation of extraordinary proportions. Difficulties to be overcome included—handling an anticipated 10 to 50 mgd. of sewage and runoff of melting snow; obtaining necessary heavy-duty pumping equipment, and finding sufficient labor to complete the job in the short time available. How these problems were solved will be told in the Aug. 9 issue.

- Seabee "know how" in meeting water supply problems on islands of the Pacific has been an important element in advancing our military gains. Some of the experiences of Construction Battalion units responsible for keeping our armed forces supplied with potable water, which began at Guadacanal, will be described in the Aug. 9 issue.

- How the use of coral helped turn the tide of battle against the Japs for repossession of Pacific islands is the subject of an article scheduled for Aug. 9 issue. This hitherto little-known material has in reality turned out to be a surprisingly good construction material, even for concrete aggregate. There are many types of coral in the Pacific, and their characteristics and relative merits, as well as how each can be used to best advantage will be told.

LOOKING AHEAD

- How South American engineers are able to design and construct buildings whose structural members are so much smaller than those we are accustomed to in this country is the subject of an article by Arthur J. Boase, manager, structural bureau, Portland Cement Association, scheduled for an early issue. Mr. Boase will discuss methods of construction and materials available, which he points out are not superior to those used by U. S. constructors. His observations from inspection of South American jobs should be of unusual interest to U. S. designers and contractors alike.

- Effect of moisture on compacted soils is the subject of a forthcoming article of special interest for highway engineers. Experiments show that road and runway surfaces fail largely because of poor protection for the clay subsoil from subsequent changes in moisture content; and faliure to properly consolidate the soil into an integral structure.

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DO YOU WANT AN INDEX?

Due to the paper shortage, no index for volume No. 134 (Jan.-July, 1945) will be issued except to subscribers who ask for it. If you want a copy of the index please send in the coupon below.

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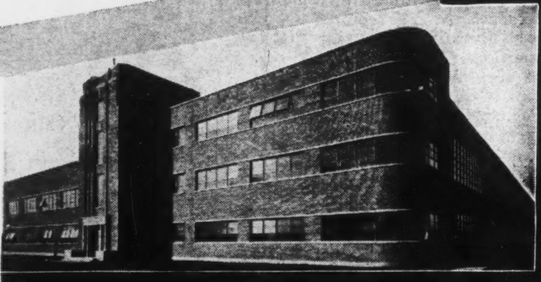
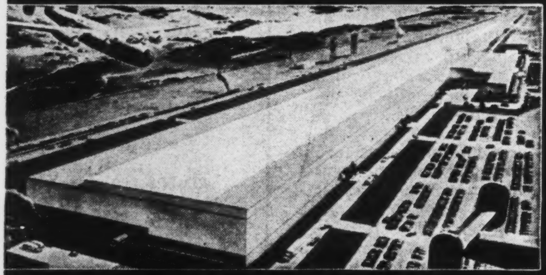

Truscon Commercial Projected Steel Windows in the Hygrade Sylvania Corp. office building, Danvers, Mass.


Truscon Ferroglas construction in large southwestern bomber assembly plant.

Truscon Pivoted Steel Windows in office, Pivoted Steel Windows in factory, and Open-Truss Steel Joists in Sanders Tri-Cleaning Co. plant, Detroit, Mich.

Truscon Steel Hangar Doors in large midwestern bomber assembly plant.

Truscon Commercial Projected Steel Windows in office, Pivoted Steel Windows in factory, and Open-Truss Steel Joists in Progressive Welder Co. plant, Detroit, Mich.

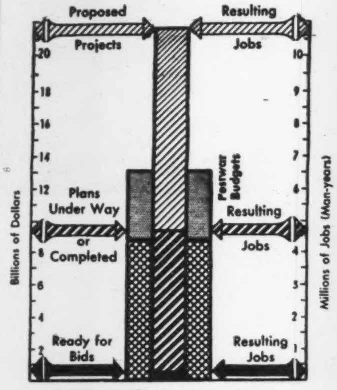
Postwar Planning Progress Report

A BACKLOG of $21,439,008,000 in identified and recorded postwar construction volume has been built up in two and one-half years according to reports to *Engineering News-Record.* Forty-three percent of this proposed total, $9,272,334,000 has engineering plans under way or completed.

POSTWAR ENGINEERING CONSTRUCTION VOLUME PROPOSED, PLANS UNDERWAY OR COMPLETED, AND READY FOR BIDS

Status of postwar planning reported to ENR compared with annual postwar construction budget based on assumed National Income of $150,000,000,000 per year.

(Jan. 1, 1943 to June 28, 1945)



(Assuming that $1 of construction volume produces 1 man-hour of labor, ⅓ on site)

During the four weeks of June *ENR* recorded $351,571,000 in new proposed projects and $231,769,000 in projects in the planning stage. Both of these monthly volumes are below their respective 30-month averages for new work reported—proposed volume 51 percent under the average of $716,000,000 per month, and planning stage volume 25 percent below its monthly average of $310,000,000.

Projects ready for bids with plans finished and land, legal and financing obstacles overcome total $743,982,000 for the period from January 1943 through June 1945. An additional $395,487,000 worth of projects have planning completed but lack financing, and projects valued at $679,912,000 have funds available but planning unfinished.

The volume ready for bids is equivalent to an investment of $5.60 for each person in the nation. The planning stage investment, on a per capita basis, equals $70.50, and proposed per capita volume **amounts to** $163.00.

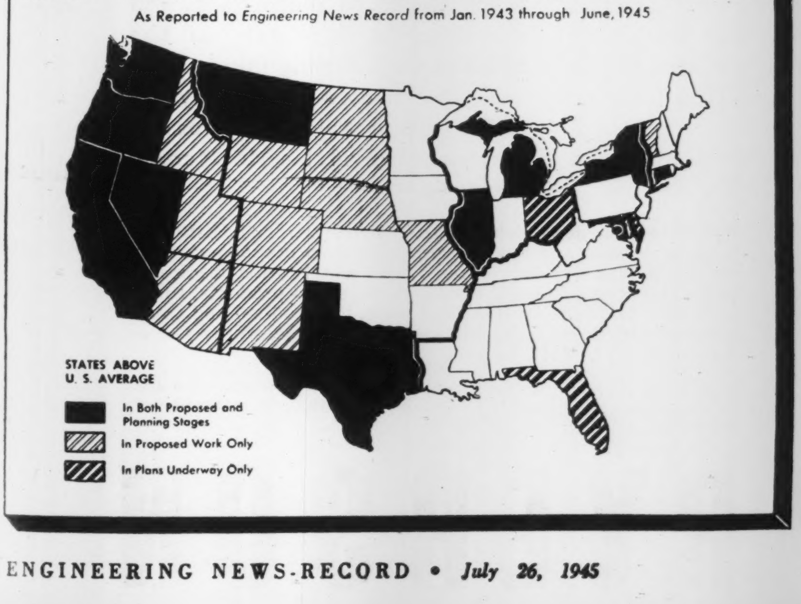
Six states—New York, Maryland, Florida, Michigan, Texas and Oregon—are above the U. S. per capita average in the ready-for-bids stage. New York reports a $29.70 ready-for-bids per capita volume, the highest in the nation. Florida. with $29.00 per person, **is next in line.**

Fourteen states and the District of Columbia exceed the $70.50 planning stage per capita average, and eleven of these states and the District also top the proposed per capita total for the country as a whole.

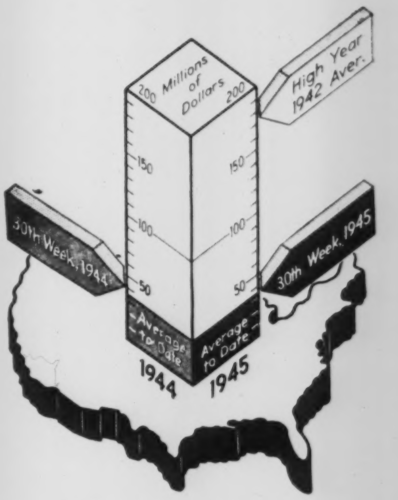
(*Postwar Project Reports page* 132)

HIGHEST RANKING STATES IN POSTWAR CONSTRUCTION PLANNING

As Reported to *Engineering News Record* from Jan. 1943 through June, 1945


STATES ABOVE U. S. AVERAGE
In Both Proposed and Planning Stages
In Proposed Work Only
In Plans Underway Only

CONSTRUCTION ACTIVITY



As Reported This Week to...
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of July 26 1945	Cumulative 1945 (30 wk.)	Cumulative 1944 (30 wk.)
Federal	$15,569	$574,872	$675,721
State & Munic.	15,021	173,618	134,896
Total Public..	$30,590	$748,490	$810,617
Total Private.	10,500	298,649	239,774
U. S. Total...	$41,090	$1,047,139	$1,050,391

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

	Dollar Volume (Thousands)		
Type of Work	This Week	Cumulative 1945 (30 wk.)	Cumulative 1944 (30 wk.)
Waterworks	$1,339	$25,112	$17,479
Sewerage	557	16,896	16,952
Bridges	4,657	19,595	7,980
Highways	5,197	121,639	120,024
Earthwork, Waterways	2,165	23,528	34,818
Buildings, Public.	11,240	352,221	372,330
Industrial	6,401	202,208	105,770
Commercial ...	1,881	58,841	98,967
Unclassified	7,653	227,089	276,071

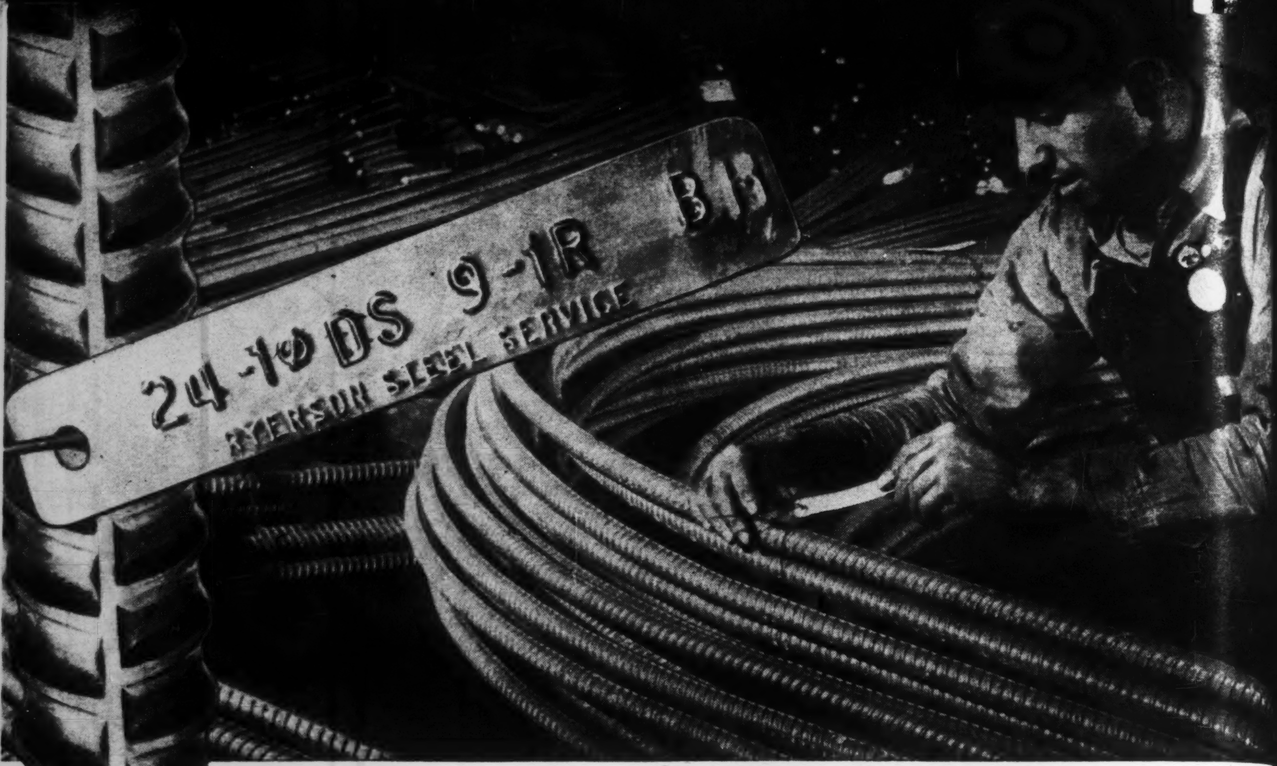
NOTE: Minimum size projects included are: Waterworks and waterway projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1945 (30 wk.)	Cumulative 1944 (30 wk.)
NON-FEDERAL	$480,375	$290,491
Corporate Securities.	90,408	85,845
State and Municipal.	226,367	65,186
RFC Loans	24,600	56,460
REA Loans	60,000	20,000
Fed. Aid, Highway..	79,000	63,000
FEDERAL	$1,005,325	$1,263,800
Total Capital	**$1,485,700**	**$1,554,291**

ENR INDEX NUMBERS

Index Base = 100		1918	1926
Construction Cost..	July '45	308.99	148.53
Building Cost.....	July '45	239.64	129.54
Volume	June '45	133	58



Hi-BOND Reinforcing *Tagged* for Quick Assembly

One of the most helpful services performed on Ryerson Reinforcing Steels is accurate *tagging*. Individual metal tags are wired to each lot of steel. By using code identification it becomes a simple matter to cross reference all bars with the bar markings of your blue print, and further identify the location of the bars with reference to the beam or slab schedule.

This added service coupled with a steel-when-you-need-it delivery, contributes greatly to the efficiency of your construction crews—saves money for you. No lost time in measuring, counting, or hunting for the right stock. This service, which means so much, costs you nothing. It is a part of the Ryerson way of doing things. It is one of the many reasons why you'll find it pays to bring your plans and problems involving steel to Ryerson.

Ryerson—your dependable source. Specify Inland Hi-BOND bars—cut, bent, and tagged. Other Ryerson products include: spirals, welded wire fabric, removable metal forms, fabricated structural steel, plates, sheets, bars, threaded products, tubes, etc.; road materials such as road mats, longitudinal and transverse joints, dowel bars, expansion joints, etc. Write for informative Hi-BOND Bulletin.

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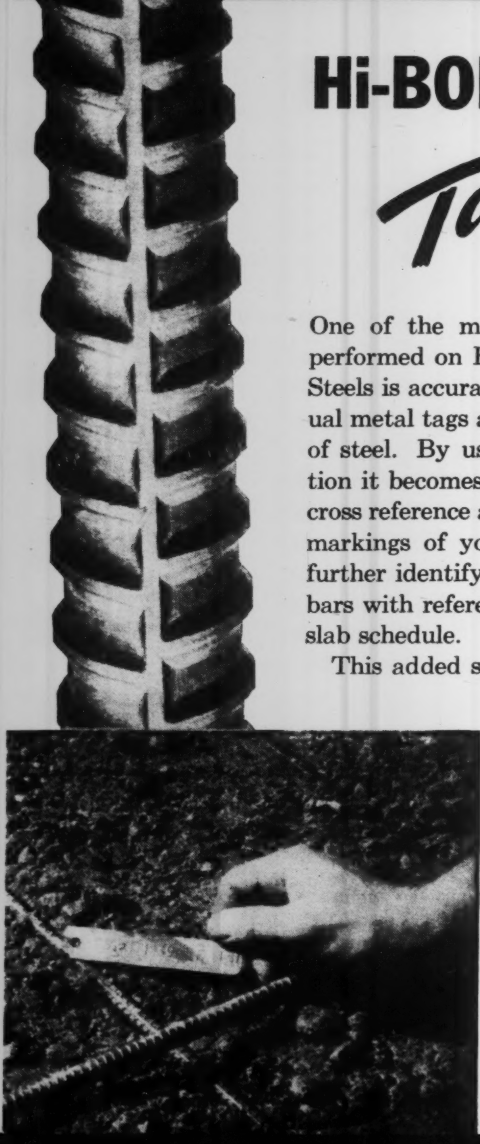


Construction Trend Starts Up In First Half 1945

Construction activity has quickened its tempo and started up from its war low to close the first half of 1945 with a total of $876,155,000 recorded by *Engineering News-Record* for heavy engineering construction.

The rising tempo of current contruction can be seen from the following relations:

1945 Construction lagged behind 1944 Volume:

At the end of February 28%
At the end of April 12½%
At the end of June.................. 2%

Another measure of this improvement is given by comparing previous 4-weeks moving averages, which climbed from $27,379,000 at the end of February to $47,650,000 as June closed a rise of 74% in four months:

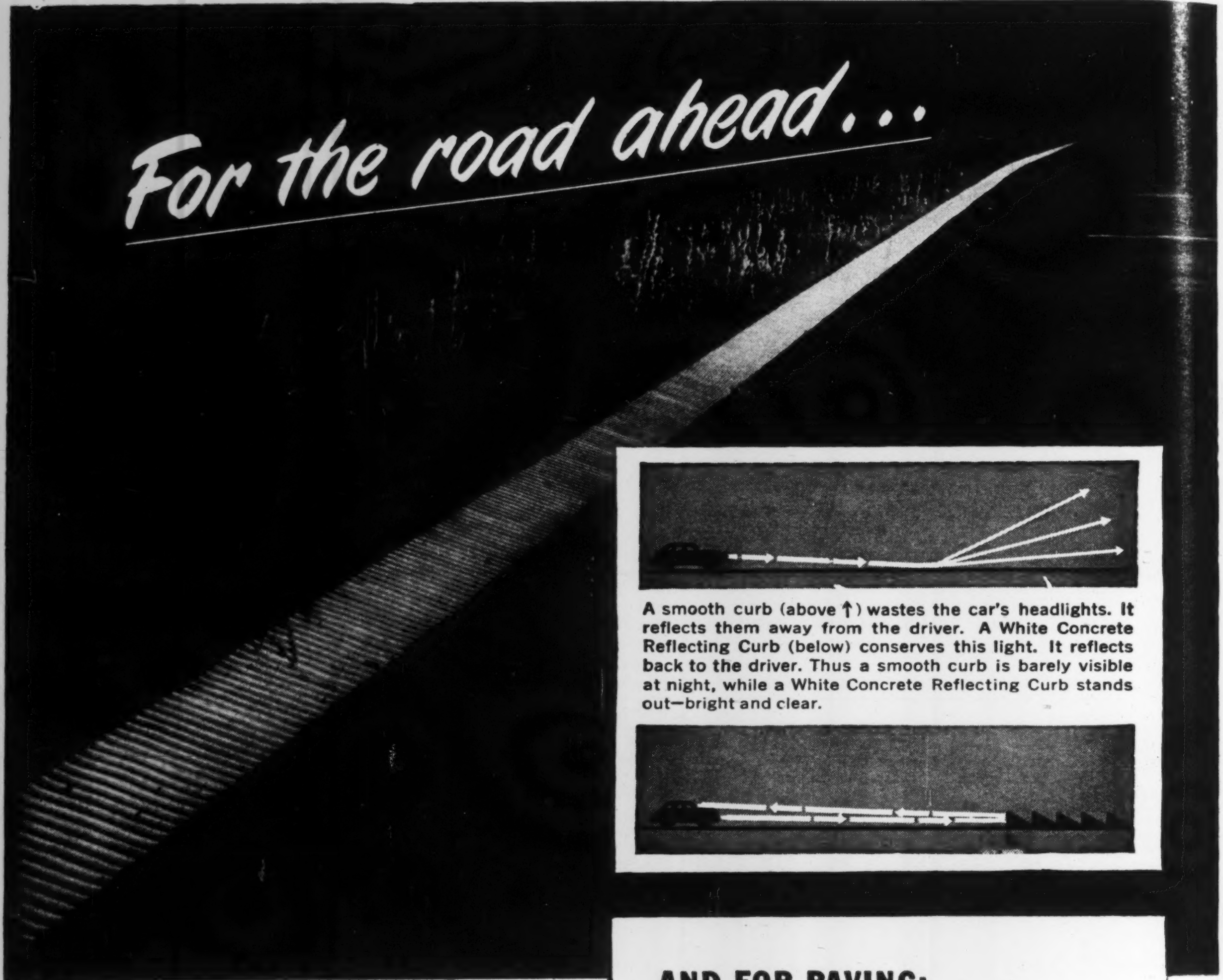
At the end of:	Previous 4-weeks Moving Average	% Increase
February	$27,379,000	—
April	35,095,000	28%
June	47,650,000	36%

A volume of $1,274,000,000 is conservatively estimated for the 2nd half to bring the 1945 estimated year's total to $2,150,000,000. It may be possible to raise this estimate later in the year if technical manpower as well as construction labor and materials become available in greater quantities than are in sight at this writing.

ENGINEERING CONSTRUCTION REPORTED BY ENGINEERING NEWS-RECORD—FIRST HALF 1945

Minimum contracts reported: Waterworks, excavation, drainage and irrigation, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.
(Thousands of Dollars—000 omitted)

						BUILDINGS					All Construction				
States	Water-works	Sewer-age	Bridges	Earth-work	Streets and Roads	Indus-trial	Com-mercial	Public	Un-classified	Federal Gov't. Work	Private	Public	1945 Total 26 Weeks	1944 Total 26 Weeks	% Change 1944 to 1945
Maine	100	126	76		26	388	300	880	194	1,200	688	1,402	2,090	2,724	−23
New Hampshire	49		232			195					195	281	476	834	−43
Vermont		134	30			142		6	15	6	157	170	327	68	+381
Massachusetts	669	354	244	242	1,085	4,658	1,240	8,329	5,022	10,543	5,955	15,888	21,843	8,827	+148
Rhode Island	27		280	79	46	380	2,520	386	1,374	1,323	3,185	1,907	5,092	5,758	−12
Connecticut	64	110	67	60	571	2,290	1,385	3,084	459	2,604	3,745	4,345	8,090	6,833	+18
New England	**909**	**724**	**929**	**381**	**1,728**	**8,053**	**5,445**	**12,685**	**7,064**	**15,676**	**13,925**	**23,993**	**37,918**	**25,044**	**+51**
New York	368	2,194	290	80	1,217	5,943	750	5,650	4,245	10,107	6,693	14,044	20,737	15,576	+33
New Jersey	42		51	380	627	4,406	804	6,559	2,609	8,857	5,470	10,008	15,478	40,725	−62
Pennsylvania	959	304	3,268	325	5,689	14,927	4,615	16,578	4,336	20,315	22,477	28,524	51,001	39,443	+29
Maryland	372	1,116		27	1,936	1,391		10,239	7,624	19,095	1,391	21,314	22,705	29,377	−23
District of Columbia	223	680	33		694			7,916	368	8,432		9,914	9,914	6,946	+43
Delaware						150		250	150	400	150	400	550	2,445	−77
Middle Atlantic	**1,964**	**4,294**	**3,642**	**812**	**10,163**	**26,817**	**6,169**	**47,192**	**19,332**	**67,206**	**36,181**	**84,204**	**120,385**	**134,512**	**−11**
Virginia	358	1,342	1,087	297	4,677	175		17,929	2,834	23,053	1,175	27,524	28,699	33,561	−14
West Virginia	28		65		2,471	6,075		653	771	1,452	6,075	3,988	10,063	8,261	+22
North Carolina	788	129		80	1,263	990	573	4,792	4,991	10,258	1,607	11,999	13,606	10,539	+29
South Carolina	108	33		176	58	148		1,346	634	2,097	348	2,155	2,503	6,818	−63
Georgia	108		230		3,929	317	400	4,678	1,756	6,333	717	10,701	11,418	11,332	+1
Florida	1,345	169	933	263	5,131	2,375		4,334	13,684	17,339	4,275	23,959	28,234	33,652	−16
Alabama	31	222	445	73	3,756	541	250	10,863	6,857	16,718	1,953	21,085	23,038	10,645	+116
Mississippi	30	84		88	50	104	150	2,475	1,603	2,987	1,394	3,190	4,584	6,664	−31
Louisiana	561	91	312	1,909	1,440	630		811	2,904	3,615	2,578	6,080	8,658	18,133	−52
Kentucky	14		186		5,194	350		3,061	1,389	3,571	1,165	9,029	10,194	5,159	+97
Tennessee	201		102		847	2,450		6,469	757	7,214	2,500	8,326	10,826	10,819	
Southern	**3,572**	**2,070**	**3,360**	**2,886**	**28,816**	**14,155**	**1,373**	**57,411**	**38,180**	**94,637**	**23,787**	**128,036**	**151,823**	**155,583**	**−2**
Ohio	1,487	94	341	143	6,925	9,974	3,150	4,504	2,891	7,317	13,355	16,154	29,509	28,288	+4
Indiana	439				4,381	582		11,995	842	13,634	582	17,657	18,239	19,262	−5
Illinois	1,426	915	1,309	641	6,418	28,785	1,877	6,923	3,159	8,615	32,765	18,688	51,453	22,773	+126
Wisconsin	765	368	38		1,162	5,177	150	5,441	415	5,141	5,742	7,774	13,516	25,963	−48
Michigan	86		25		1,771	16,419	477	5,351	1,294	6,331	16,921	8,502	25,423	15,383	+65
Middle West	**4,203**	**1,377**	**1,713**	**784**	**20,657**	**60,937**	**5,654**	**34,214**	**8,601**	**41,038**	**69,365**	**68,775**	**138,140**	**111,669**	**+24**
Minnesota	648			27	1,176	4,295		779	532	115	4,795	2,662	7,457	4,147	+80
Iowa			172	78	2,509	330		1,382	213	1,259	456	4,228	4,684	5,941	−21
Missouri	152	102	207	201	1,732	2,810	157	4,695	3,064	4,967	5,664	7,456	13,120	10,267	+28
Arkansas	200		46	71	319	75		1,443	414	1,828	242	2,326	2,568	3,792	−32
North Dakota	86			18	1,222	240		1,719	44	1,735	284	3,045	3,329	1,231	+170
South Dakota	24				80			288	560	760	40	912	952	329	+190
Nebraska	121		30	240	1,675	290		7,111	1,222	8,901	322	10,367	10,689	10,386	+3
Kansas	128	142	70	235	1,756	873		2,850	1,644	4,284	1,242	6,456	7,698	5,381	+43
Oklahoma	1,376	90	903	363	1,163	125		10,989	1,402	13,663	645	15,766	16,411	13,395	+23
Texas	2,933	2,191	187	1,423	8,629	40,200	3,792	38,869	13,612	54,550	47,107	64,729	111,836	66,764	+68
Montana	175			155	265	140		1,379	985	1,602	1,086	2,013	3,099	5,759	−46
Wyoming		440	63		320			569	743	1,031	721	1,414	2,135	3,903	−45
Colorado	120	219			168	568	1,066	1,258	1,562	2,470	2,176	2,785	4,961	4,783	+4
New Mexico				130	1,178	1,730		3,997	2,167	6,294	1,730	7,472	9,202	3,047	+202
West of Miss.	**5,963**	**3,184**	**1,678**	**2,941**	**22,192**	**51,676**	**5,015**	**77,328**	**28,164**	**103,459**	**66,510**	**131,631**	**198,141**	**139,125**	**+42**
Idaho		30		401	346	100		413	209	1,002	242	1,257	1,499	3,492	−57
Utah	89		192		241	80	1,900	1,428	1,144	2,759	2,071	3,003	5,074	10,032	−49
Arizona				337		195		219	3,507	4,000	245	4,013	4,258	6,945	−39
Nevada				2,606	57			5,001	3,990	9,327	2,250	9,404	11,654	5,242	+122
Washington	564	322	375	270	3,342	1,589	2,290	15,074	6,342	20,799	5,034	25,134	30,168	25,068	+16
Oregon	288		768	932	2,187	3,094		5,568	1,847	8,211	3,253	11,431	14,684	15,819	−7
California	2,245	2,622	227	7,521	4,483	14,055	16,444	49,194	65,620	119,192	33,992	128,419	162,411	258,299	−37
Far West	**3,186**	**2,974**	**1,562**	**12,067**	**10,656**	**19,113**	**20,634**	**76,897**	**82,659**	**165,290**	**47,087**	**182,661**	**229,748**	**325,897**	**−29**
U. S. 1945 (1st 6 Mo.)	**19,797**	**14,623**	**12,884**	**19,871**	**94,212**	**180,751**	**41,290**	**335,727**	**184,000**	**487,306**	**256,855**	**619,300**	**876,155**		
U. S. 1944 (1st 6 Mo.)	13,975	13,629	6,748	32,691	97,637	83,000	88,541	333,624	221,985	580,913	201,481	690,349		891,830	
% Change '44 to '45	**+42**	**+7**	**+91**	**−39**	**−3**	**+118**	**−50**	**−8**	**−17**	**−16**	**+28**	**−10**			**−2**
Canada, 1945	2,203	424	1,052	400	3,278	21,893	9,401	15,650	1,903		31,809	24,395	56,204		
Canada, 1944	307	332	974	103	4,303	14,317	2,641	7,176	14,519		17,480	27,192		44,672	+26



A smooth curb (above ↑) wastes the car's headlights. It reflects them away from the driver. A White Concrete Reflecting Curb (below) conserves this light. It reflects back to the driver. Thus a smooth curb is barely visible at night, while a White Concrete Reflecting Curb stands out—bright and clear.

A NEW CURB...

designed for greater safety

White Concrete Reflecting Curb dominates the road by day and lights it up by night. Made with Atlas White Cement, its reflecting faces catch the rays from a car's headlamps and reflect them brightly back to the driver. This makes a continuous ribbon of reflected light which guides the driver safely and comfortably along the road. Write for full details about—

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The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • JULY 26, 1945 • VOLUME 135 • NUMBER 4

Bid handling procedure changed by Army Engineers

Chief of Engineers instructs division engineers to open bids on construction work publicly but to continue to negotiate with bidders for contract

In an effort to bring the contract procedures of the Corps of Engineers as close to peacetime methods as is possible under wartime conditions, the Chief of Engineers, on July 21, issued instructions to division and district engineers modifying previous instructions with respect to the letting of contracts for construction work to be carried out by the corps (*ENR*, June 7, vol. p. 861, June 21, vol. p. 861, and June 28, vol. p. 875).

The major change made by these new instructions is to authorize the public opening of bids on most work done by the Army Engineers. All contracts still must be negotiated under War Production Board orders.

Instructions revised

Under the earlier instructions, no public calls for bids and no public openings were permitted. Bids were to be solicited from a selected list of contractors, and after bids had been opened privately, negotiations were to be started with the low bidder. Not until after an agreement as to the amount had been reached could the amount of the other bids be made public.

Instructions issued to the division engineers on July 21 read in part as follows:

A. **All contracts** will be awarded on the basis of negotiation under the First War Powers Act, 1941, Executive Order 9001.

B. For lump-sum contracts, the general rule will be that offers will be solicited from the largest list of qualified contractors consistent with the size and nature of the job. Public opening of offers submitted will be held by the contracting officers with representatives of the contractor. Offers will be carefully considered and award will be made only after negotiation with the contractor submitting the offer which is most favorable to the government, taking into consideration all factors influencing the bid price. Contractors' estimated costs of performance will be carefully scrutinized and compared with the government estimates. Normally, the low offerer stands in the most favorable position but his offer will be carefully analyzed and compared with actual experience costs of similar jobs where available.

C. Plans and specifications and lists of contractors invited to bid will be furnished persons having a legitimate interest therein.

With respect to the new instructions, Lieut. General Eugene Reybold, Chief of Engineers, in a letter to *Engineering News-Record*, states:

"Your explanation of my position in this matter was stated in the 28 June, 1945, issue of the *Engineering News-Record*. After further consideration, I have modified existing instructions so that in the case of lump-sum construction and dismantling contracts, the usual practice will be followed of publicly opening bids and of furnishing parties having a bona fide interest with lists of prospective bidders and with plans and specifications prior to award. Exceptions to this procedure will be only in unusual circumstances where projects are classified and where it is considered not in the public interest.

"Contracting officers will continue to negotiate all contracts in accordance with amended Directive No. 2 of the War Production Board and War Department procurement regulations even though bids will be read publicly in the future. The procedure outlined above will be applicable to both military and civil-works construction."

Federal Works Agency

More water for washing Illinois coal

Built to meet increasing industrial needs in the coal mining area of Franklin County, Ill., "Lake West Frankfort" augments existing water storage facilities by impounding 556,000,000 gal. The new storage replaces a temporary steel conduit laid above ground from a source at Benton, 8 mi. away. Also included in the $257,000 expansion of the West Frankfort water system are 8,850 ft. of 14-in. C. I. pipeline, a pumping station, a power line and other appurtenances.

Major need for the added water facilities is the washing of bituminous coal, demand in the area having increased from 940,000 gpd. in 1941 to 1,237,000 gpd. in 1943, with a 2,695,000 gpd. demand expected in the near future as more old coal mines reopen to meet increasing war requirements.

Aid for research and students proposed in federal legislation

Bill sponsored by Kilgore Committee of Senate fosters scientific research in colleges and aid medical and science students

Establishment of the National Science Foundation to foster research in the sciences and to insure an adequate and continuing supply of scientists is called for in legislation introduced in the Senate on July 23 by Senator H. M. Kilgore, chairman of the Subcommittee on War Mobilization of the Senate Committee on Military Affairs. At the same time the subcommittee made public Part II, Findings and Recommendations, The Government's Wartime Research and Development.

Government-performed and government-financed research, the committee states in its findings, were primarily responsible for the great advances made in military science during the war. "We cannot afford to slacken our efforts in the fight for peacetime prosperity and permanent security."

National Science Board

A National Science Board is proposed by the committee, which is to be made up of the Secretaries of War, Navy, Interior, Agriculture, Commerce and Labor and the Attorney General and head of the Federal Security Agency or their representatives and eight members appointed by the President. Administration of the National Science Foundation would be placed in the hands of a director, appointed by the President, who would consult with the board on allocation of funds and special advisory research committees.

The foundation would do no research but would aid research in schools and private laboratories and would participate in formulating research programs believed to be in the public interest, using funds appropriated by Congress for that purpose.

Subjects to be considered are: national defense; health and medical care; basic sciences; natural resources; methods, products and processes that may be valuable for small business enterprises; and peacetime uses for wartime research and facilities. At least 20 percent of each annual appropriation is to go for each of the first three categories.

At least 50 percent of the money is to be spent in non-profit educational institutions and research foundations.

All discoveries in research financed in whole or in part by these funds would become the property of the United States.

The Kilgore committee also recommends that the foundation be empowered to grant fellowships and scholarships in various fields of science to "develop scientific talent, particularly in American youth."

Committee proposals endorsed

More details of what may develop into federal policy with respect to research are given in a report to the President by Vannevar Bush, head of the Office of Scientific Research and Development, made public last week. Prepared at the request of the late President Roosevelt, this report suggests that ultimately the government should finance 24,000 undergraduate scholarships and 900 graduate fellowships each year at approximately the amounts specified in the G I Bill of Rights. This would cost about $30,000,000 annually.

Aids for research

More details of the proposed National Research Foundation are given in the Bush report. Assuming that five years will be required to bring the work of the foundation up to full efficiency, the report recommends a budget of $122,500,000 for the fifth and subsequent years, to be divided as follows: Medical research, $20 million; natural sciences, $50 million; national defense, $20 million; scientific personnel and education, $29 million; publications and administration, $3.5 million.

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Substructure awarded for bridge at Memphis

Merritt-Chapman Scott Corp. of New York has been awarded a $4,333,174 contract for construction of the seven main piers for a four-lane highway bridge over the Mississippi River at Memphis. Work will be financed jointly by the highway departments of Tennessee and Arkansas with some help from the city of Memphis. The bridge is located at Iowa St., just downstream from the existing Harahan highway bridge and the Frisco R.R. crossing.

Other bids submitted were—Kansas City Bridge Co. and Massman Construction Co., $4,369,960; Dravo Corp., $4,633,710; Four Companies, Inc., (Boston, Mass.), $5,393,642; Missouri Valley Bridge and Iron Co., Morrison-Knudson Co. and Winston Bros. Co., $7,438,930.

Four of the piers will be sunk by the pneumatic caisson method. They will go to a depth of about 89 ft. below mean low water and will have a total height of 200 ft. The other three main piers will be sunk as open caissons.

Bids for 481 ft. of pile-founded reinforced concrete trestle on the Arkansas side were opened and rejected. The work can be done in much shorter time than the main piers and it is hoped that a lower bid may be received later. Four bids ranged from a low of $569,340, submitted by La Crosse Dredging Corp., to $688,260.

The superstructure will be a cantilever with a channel span of 790 ft., but it is not expected that bids will be asked for several months. Original estimate of the cost of the bridge was $8,000,000 but, on the basis of bids received last week, the estimate has been increased to $10,500,000. Modjeski & Masters of Harrisburg, Pa., are the engineers for the structure, under the Tennessee and Arkansas highway departments.

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W. W. Horner nominated for A.S.C.E. president

Wesley W. Horner, consulting engineer of St. Louis, Mo., was nominated last week to be president of the American Society of Civil Engineers for 1946. Nomination of a president usually is made at the October meeting of the society's board of direction, but this action was taken at the July meeting in Detroit because of the late date set for the board's fall meeting. Election is by mail prior to the annual meeting of the society in January.

Mr. Horner was born in Missouri in 1883, and received his civil engineering education at Washington University, St. Louis. Upon graduation he became surveyor with the water division of the St. Louis Board of Public Service. By 1918 he was chief engineer of sewers and paving. In 1933 he entered private consulting practice. In 1937 he was appointed professor of municipal and sanitary engineering at Washington University, resigning in 1941 to devote more time to consulting work in the municipal and hydraulic engineering fields.

Mr. Horner has been active in the affairs of the American Society of Civil Engineers for many years. In addition to serving as a director in 1933-35, he was president of the St. Louis Section. He is now chairman of the committee on definitions in sewerage and sewage disposal practice and chairman of the committee on hydrology.

Revised construction plans revealed for Columbia Basin irrigation project

Major changes in structures to store water pumped from reservoir behind Grand Coulee Dam announced as landowners vote favorably on repayment plans for project

Virtually on the eve of an election among landowners in the Columbia Basin in the State of Washington to determine whether they will accept the repayment terms set by the U. S. Bureau of Reclamation, federal officials revealed that major changes had been made in the plans to irrigate that basin with water stored behind Grand Coulee Dam.

Columbia Basin is a fertile but semiarid region 2,500,000 acres in extent lying south of Grand Coulee Dam on the Columbia River. Under the original plans for the project, water impounded by Grand Coulee Dam was to be pumped up into a reservoir formed in the Grand Coulee itself, which is a prehistoric gorge of the Columbia River, from whence it was to flow, largely by gravity, to irrigate about half the land in the Columbia Basin. Most of the secondary and some of the primary power generated at Grand Coulee Dam is to be used for pumping while the remainder is to be sold to help offset the cost of the irrigation project.

Four dams to be built

Dams at each end of the Coulee were called for in the earlier plan, to form a reservoir of 1,050,000 acre-ft. capacity. Somewhat smaller dams are proposed in the new plans, to form a reservoir of 700,000 acre-ft. capacity. In addition, two more dams are to be built farther south in the area to be irrigated. The dam at the north end of the Coulee, known as North Coulee Dam, is to be 1,360 ft. long and the South Coulee Dam 9,880 ft. Both are to be earth and rockfill structure.

A third structure, Long Lake Dam, is to be built about 12 miles south of South Coulee Dam. It also will be an earth and rockfill structure 1,650 ft. long.

Largest of the four proposed structures is the Pothole Dam, 15,000 ft. long and 110 ft. high, a rolled fill containing 15,000,000 cu. yd. of earth and rock. It is to be located in the central part of the basin spanning Crab Creek channel and serving to impound seepage and return flow from about one third of the lands in the basin.

In addition to the dams, the project calls for construction of 488.7 miles of canals, 66 siphons, and four tunnels with a total length of 25,150 ft. These will deliver water to 1,029,000 acres. Drops in the canals will be used to develop power to pump water to lands beyond the reach of gravity flow.

Power to pay for irrigation

The cost of serving each acre of land is estimated at $280. About $200 of this is to be repaid by power sales, leaving around $85 as the charge against the land. Under the terms of the contract put before the landowners at the July 21 election, the construction cost to be charged against land would not exceed $85, to be paid on an interest-free basis over 40 years. Total cost of the work is put at $280,000,000, of which $200,000,000 is expected to be spent in the first decade after the war.

A favorable vote was cast at the election, hence an early postwar start is anticipated. The work will be done by the Bureau of Reclamation under the general direction of H. W. Bashore, commissioner and Walker R. Young, chief engineer.

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Bove gets long sentence for union funds theft

James Bove, union official convicted of looting Yonkers Local 60, International Hodcarriers, Building and Common Laborers Union of $64,575, was sentenced July 19 by County Judge Frederick G. Schmidt of Westchester County, N. Y., to serve from 10 to 20 years in Sing Sing Prison.

This sentence is in addition to one of from 8½ to 15 years in Sing Sing imposed upon him in New York City after his conviction for extortion and conspiracy. Both convictions grew out of investigations into activities of union officers in connection with the construction of the $300,000,000 New York City-Delaware River Aqueduct.

Defense counsel will apply for a certificate of reasonable doubt to permit Bove's release on bail. Bove was granted such a certificate in the New York case and is on $25,000 bail there.

Rhine bridge builders now in the Philippines

The first Engineer troops to arrive in the Philippines direct from the European Theater debarked in Manila July 22. Units to which the 5,000 men belong included petroleum distribution companies, general service regiments and port construction and repair groups, each of whom had contributed important construction achievements to victory over the Germans. Among these is the 1053rd Port Construction & Repair Group, under the command of Col. George F. Griffith, partner with the 332nd Engineer General Service Regiment in setting the Rhine bridge building record of 6 days, 15 hr. for the 2,815 ft. railroad crossing from Rheinhausen to Duisburg.

It is not announced whether or not the 332nd is with the 1053rd at Manila. Another well known unit arriving to start its second war is the 1061st P. C. & R. Group, which contributed greatly to the rebuilding work at the port of Le Havre. It is under the command of Col. William P. Moss.

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Quarter billion dollars for private reconversion

Preferential ratings for construction and equipment necessary for industrial reconversion have been granted by the War Production Board on about 1,400 applications. Such ratings permit the start of construction on plants and conversions estimated to cost in excess of $90,000,000 and purchase of equipment valued at $160,000,000.

At the close of business July 12, iron and steel products had had over 300 applications approved with a value of over $50,000,000, of which $22,000,000 was for construction and $28,000,000 for equipment. Automobiles and similar equipment have had applications approved for construction amounting to about $50,000,000, with $100,000,000 for equipment. Machinery, other than electrical, ranked third with applications approved for nearly $10,000,000 of construction and $20,000,000 for the equipment.

Geographically, Michigan is far in the lead with applications approved for $115,000,000 for construction and equipment, chiefly for the automotive industry. Indiana and Ohio each have had applications approved totaling more than $20,000,000, while Pennsylvania and Illinois are in the $15,000,000 class with New York and Tennessee listed at about $13,000,000 for construction and equipment combined.

Basic wage increases now before Congress

Identical bills calling for an increase in basic wage rates were introduced into both houses of Congress last week, following a recommendation of the Senate Committee on Education and Labor that the Fair Labor Standards Act of 1938 be amended to make any wage below 65 cents substandard in interstate commerce. This action followed closely a recommendation from the Congress of Industrial Organizations that the President authorize the War Labor Board to permit wage increases that would bring minimum wages up to 65 cents. At present, when reviewing appeals for wage increases, the WLB considers anything below 55c. substandard.

The bills now in Congress set the minimum rate for employees engaged in interstate commerce at 65c. for the first year after the amendment to the Fair Labor Standards Act becomes effective (120 days after its approval). This is increased to 70c. for the second year and 75c. for the third year and thereafter.

Similarly, the work week for the first year is set at 44 hr., 42 hr. for the second and 40 hr. for the third.

Time and one-half is specified for overtime unless specifically covered by collective-bargaining agreements.

As the House has recessed until October, no final action can now be taken.

The possible effect of such legislation on the cost of construction is difficult to determine, as not all construction is classed as being in interstate commerce. In the tabulations of construction wage rates compiled by *Engineering News-Record*, the only common labor rates below 65c. are at Atlanta and Dallas.

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Big Bolivian highway goes to American firm

The Compania-McGraw-Warren, S. A. was awarded a $9,500,000 contract on July 16 for constructing a 250 mi. highway to connect the towns of Cochabomba and Santa Cruz in Bolivia, according to G. Rovira, commercial attache to the Bolivian embassy in Washington, D. C. The firm, which is a combination of the Warren Bros. Co. of Cambridge, Mass., and F. H. McGraw Co., of Hartford, Conn., will start work in 30 days and is expected to complete the project in three to four years.

The highway crosses a mountain range over 10,000 ft. high. It starts at an elevation of 8,500 ft. at Cochabomba and descends to about 1,200 ft. at Santa Cruz. An all-weather road surfaced with asphalt is planned. Most engineers and technicians will be United States citizens and American-made construction equipment will be used.

The work is being done by the Corporacion Boliviana de Fomento, which has a working capital of about $25,000,000 and is financed jointly by the Bolivian government and the U. S. Export-Import Bank. The work for the highway is being done under the direction of a small force of engineers sent to Bolivia by the U. S. public roads administration. The decision to build the highway was made after an economic mission sponsored by the U. S. State Department visited Bolivia in 1942.

JOBS OF THE WEEK

INTERNATIONAL HIGHWAY, Panama City, Panama

Republic of Panama, Panama City, will construct by day labor International Highway from Rio Hato to Costa Rican boundary, at an estimated cost of $16,000,000.

AIRPORT, Idlewild, N. Y.

Atlantic, Gulf & Pacific Co., New York, N. Y., were the lowest bidders for hydraulic fill at Idlewild Airport at $3,088,453. The Department of Marine & Aviation, New York, N. Y. opened bids.

STORAGE and PLANT, Winnipeg, Man.

Dominion Malting Co., Winnipeg, Man., awarded a contract for storage and plant extensions to Commonwealth Construction Co., Ltd., Winnipeg, at $1,160,251.

SPORTS ARENA, Mexico City, Mexico

Mexican Industrial Bankers, Care of Negrib Simon, San Angel, Mexico City, will construct a sports arena. The estimated cost is $8,000,000. Work will be done by local labor.

HOUSING, Bremerton, Wash.

Nettleton & Baldwin, Seattle, Wash., were the lowest bidders at $1,407,376 for constructing 616 housing units, East Bremerton, Wash., when Public Housing Authority, Seattle, opened bids. Naramore, Bain, Brady & Johnson, Seattle, are the architects.

EARTHWORK, CONCRETE LINING, Friant, Calif.

Bureau of Reclamation, Friant, received the lowest bid for earthwork, concrete lining, structures, Station 6 plus 10 to Station 301 plus 60, Friant Kern Canal, Friant Division, Central Valley Project, from Peter Kiewit Sons Co., San Francisco, at $1,163,340.

RADIO CABINET MANUFACTURING PLANT, Jackson, Miss.

Owner, care of Sears Roebuck Co., Chicago, Ill., awarded a contract to build radio cabinet manufacturing plant to J. A. Jones Construction Co., Charlotte, N. C. at $1,300,000. Giffils & Vallet, Norfolk, Va., are the engineers and architects.

SIGNAL DEPOT, Sacramento, Calif.

MacDonald & Kahn, Inc., A. Teichert & Co. and John C. Gist, have been awarded a contract to build Sacramento Signal Depot, by U. S. Engineers, San Francisco, Calif. The estimated cost is $6,241,000. H. J. Brunnier, San Francisco, is the consulting engineer.

CONCRETE REVETMENT, Mississippi and Louisiana

U. S. Engineers, Vicksburg, awarded a contract for concrete revetment on Mississippi River to R. W. George Construction Co., St. Louis, Mo., at an estimated cost of $1,300,000.

AIRPORT, Wilkes Barre, Pa.

Civil Aeronautics Commission, New York, N. Y., awarded a contract for grading, paving airport to George M. Brewster & Son, Bogota, N. J., at $3,318,582.

BRIDGE, Tennessee and Arkansas.

Merritt-Chapman & Scott Corp., New York, N. Y., has been awarded a contract for seven main piers for four-lane bridge over Mississippi River at Memphis by State Highway Departments, Tennessee and Arkansas, at $4,333,174. Modjeski & Masters, Harrisburg, Pa., are the engineers.

Note—Additional bidding and contract news on many projects large and small, including the above items, appear in the Construction News section beginning on page 171.

WASHINGTON HIGHLIGHTS

President Truman has approved an appropriation sufficient to reconstruct the roofs of both the Senate and House chambers of the U. S. Capitol. The legislation approved carries forward an appropriation of $585,000 provided in the second deficiency act approved June 27, 1940, and any such additional amount as may be needed to complete the work. The work in the Senate is estimated to cost more than $800,000 and for the House chamber at least double this amount.

The House has passed a bill (H.R. 3477) authorizing the U. S. Army Engineers to improve the Savannah, Ga., harbor for navigation purposes. Estimated to cost $2,738,000, the work was inadvertedly left out of the general Rivers and Harbors Bill passed some time ago.

President Truman has signed five bills dealing with the construction of bridges over navigable streams. A bill (S. 454) was approved extending the life of the Arkansas-Mississippi Bridge Commission and authorizing the commission to construct and operate a bridge across the Mississippi at Friar Point, Miss. The time for commencing and completing a bridge across the Saint Croix River at Hudson, Wis. was approved by passage of the second bill, S. 527. Passage of a bill (S. 233) granting the consent of Congress to the state of North Dakota to construct and operate a free highway bridge across the Missouri River became law as did a bill (S. 234) authorizing the construction of a free highway bridge across the Yellowstone River near Fairview, Mont. The fifth bill to become law (S. 574) extends the time for commencing and completing construction of a bridge across the Columbia River in Clatsop County, Ore.

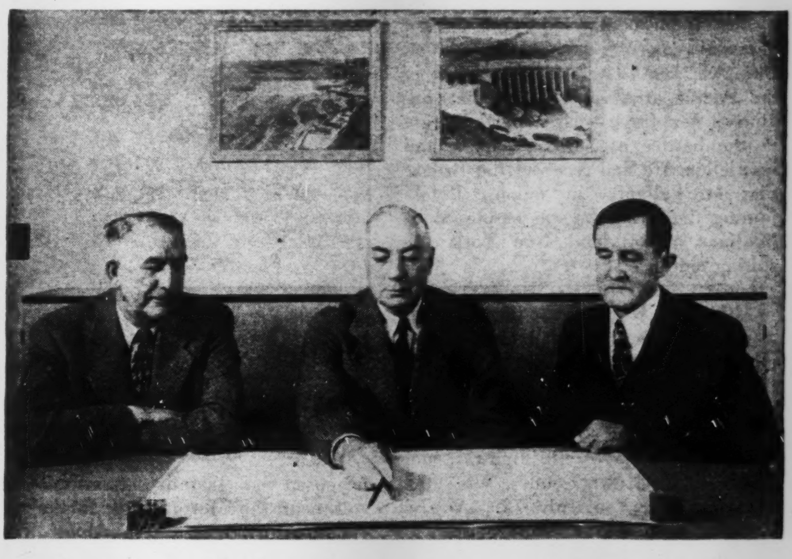
BRIEF NEWS

The War Production Board has announced that the Summit-Stark County Airport project near Greensburg, Ohio, will be restored to "full priority status". Labor and materials had been withheld after the Army notified the Civil Aeronautics Authority that the airport was not needed for military use. Akron and Canton had joined in a protest claiming that, since grading and other construction chiefly was involved, critical materials were not required and that local labor would be utilized. Early resumption of work is foreseen.

Gen. Heriberto Jara, Secretary of the Mexican Navy, has budgeted $3,750,000 as the cost of improving Manzanillo, key Pacific port and western terminus of the National Railways of Mexico. The program includes: Building a wharf, 1,000 meters long; warehouses; public edifices, including a customs house; 1,000 meters of railroad yards; a reinforced concrete bridge, 70 meters long; excavations: 300,000 sq. mtrs. of above sea rock and 250,000 sq.mtrs. of undersea rock, and dredging 600,000 mtrs. of a lagoon, using earth thus removed as a fill-in for the railroad yards. The budget is subject to President Manuel Avila Camacho's approval, and if granted, the job is expected to start at once.

A highway construction program for Texas during the first three postwar years was outlined recently to the Texas League of Municipalities by Dewitt Greer, chief engineer for the state highway department. The program will cost $157,000,000 under these divisions: $27,000,000 for highways through cities; $50,000,000 for farm-to-market roads; and $80,000,000 for extensions, widening and reconstruction of primary roads.

The Ohio Welfare Conference has endorsed the 10-year program submitted by the governor's committee on mental health, which proposed an expenditure of $36,710,000 in the next two years to expand state institutional facilities for mental patients. The complete program eventually would double present facilities, and is estimated to cost from $60,000,000 to $63,000,000.



Assistant chief engineers, Bureau of Reclamation

Part of the preparation of the Bureau of Reclamation for a broad postwar program of irrigation and multi-purpose hydraulic projects is the strengthening of the organization's personnel. Along this line is the recent appointment of three assistant chief engineers to aid Chief Engineer Walker R. Young in the Denver office.

One hundred years of combined experience in the development and utilization of the land and water resources of the West are represented by the three new assistant chief engineers pictured above. Their appointments were announced July 3 by Secretary of the Interior Harold L. Ickes. Left to right, they are: Ralph Lowry, construction; Leslie N. McClellan, electrical and mechanical; and William H. Nalder, civil.

Mr. Nalder, born in 1885, took his B.S. degree in civil engineering at Washington State College. In 1909 he began as a surveyman on the Yakima project. Becoming assistant chief designing engineer of the bureau in 1931, he assisted John L. Savage in the design of numerous dams and irrigation systems. During Mr. Savage's absence he has acted as chief designing engineer.

Mr. McClellan, born 1888, was graduated from the University of Southern California and in 1925 he became chief electrical engineer of the bureau.

Mr. Lowry, born in 1889, is a civil engineering graduate of Washington State College. He entered government service in 1914 and in 1930 he became field engineer at Boulder Dam. He served as construction engineer at Shasta Dam from 1938 until his transfer to Denver this year.

OBITUARY

Otto W. Gearlick, 57, for the past 14 years superintendent of highways for Knox County, Ill., of which Galesburg is the county seat, died July 14. He had previously served eight years as county engineer of Knox County.

Robert D. Gregg, 86, city engineer of Kankakee, Ill., since 1900, died July 14.

James H. Flynn, 60, assistant engineer in charge of the state highway department's bridge division, died in Lansing, Mich., July 14.

W. Frank Thomas, 65, one of the pioneers in the building of paved roads in Maryland, died at Westminster in that state on July 15. He was on the State Roads Commission.

Maj. Robert W. Fairman, 31, of Scarsdale, N. Y., died of wounds on Okinawa June 19. He had been in the Pacific area with the combat Engineers for three years, participating in the battles of Saipan, Tinian and Kwajelein. He had received the Bronze Star for gallantry in action. Before joining the Army, he was employed by Madigan and Hyland, New York consulting engineers.

Alfred H. Kurtz, 56, Lincoln, Neb., a civil engineering graduate of Purdue University and a construction contractor in many war projects, died while on a vacation in Canada on July 15.

Norbert P. Hayes, 48, highway commissioner of Brown County, Wis., died at Green Bay on July 12. A civil engineer graduate of Marquette University, he had been county engineer of Walworth County, and later joined the state highway department, serving in various positions including that of assistant to the division engineer in charge of maintenance.

Bert A. Withers, 66, district superintendent of street maintenance at Dallas, Tex., died at Dallas, July 7.

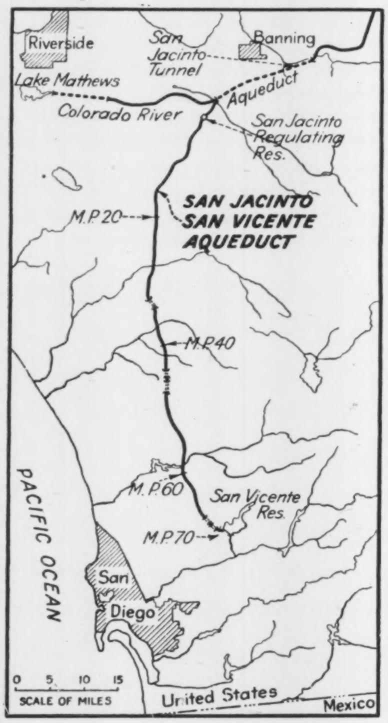
Leroy A. Gunderson, 51, engineer of the Lapeer, Mich., County Road Commission, was killed in an automobile accident at a grade crossing near Port Huron, Mich., July 14.

In World War I Mr. Gunderson was a second lieutenant. He returned to take post-graduate studies at the University of Michigan. He had been engineer in Lapeer County since 1929.

Contract let for 20 mi. of San Diego Aqueduct

Contract for 20 miles of concrete pipeline for the San Jacinto—San Vicente Aqueduct, which will link the San Diego, Calif., water system with that of the Metropolitan Water District, was awarded Concrete Pipeline Constructors, subsidiary of W. E. Callahan Construction Co. of Los Angeles, early in July.

The 20-mi. stretch, to be built at a cost of $2,248,000, will connect with the proposed San Jacinto regulating reservoir near the Metropolitan intake and run to Mile Post 23. Awarding of the contract marked the second stage in preliminaries to construction of the 71½-mi. project. The same company recently was awarded an $868,000 contract for three aqueduct tunnels, on which actual construction is expected to begin shortly.



Because of the possibility that San Diego and large naval establishments in the vicinity may be out of water by May, 1947, the Navy is pushing the aqueduct through as an emergency measure and is preparing to let contracts for the remainder of the work from time to time.

Meanwhile the San Diego County Water Authority, which was established to bring Colorado River water to San Diego, has completed its first year, and a budget of $51,700 has been approved for the ensuing year. Operated without employees until last December, the Water Authority now has established offices and acquired an engineering staff consisting of J. L. Burkholder, R. S. Holmgren, R. H. Wilkin and W. O. Byler. Mr. Burkholder heads the staff as manager.

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Wage agreement boosts Philadelphia housing

A new building trades wage agreement, reportedly the first to be signed in the United States since building was stopped in 1943, has been agreed to at Philadelphia, Pa. It provides for a flat eight percent pay increase for approximately 3,800 construction workers in the home construction field.

Alfred P. Orleans, president and William E. Johnson, executive secretary of the Home Builders Association of Philadelphia and Suburbs, and Joseph F. Burke, president, and Francis A. Foster, chairman of the organization committee of the Construction Trades Council (AFL) of the area, signed the agreement. Approval by the Wage Adjustment Board in Washington is expected.

The contract is the first to provide a flat pay rise for all types of workers in the industry and it supersedes the agreement that was in effect when building was stopped in 1943. Included in the agreement is a five-day, 40-hour week with double pay for Saturdays and Sundays.

New private housing in the Philadelphia area to cost between $12,000,000 and $15,000,000 will get under way soon as a result of the signing of the wage agreement.

Priorities for necessary materials for 2,100 houses to be built by 75 builders are expected to be granted. Ceiling price of the new houses has been set at $8,000 but many of the dwellings will be in the $6,000 class. The first new group is scheduled to be built in Northwest Philadelphia.

With some 61,500 privately-financed houses now under construction in the United States priorities for 73,000 more are in the hands of builders who can start work as soon as they are able, the National Housing Agency announced July 14.

The NHA already has programmed an additional 48,000 privately-financed houses for which priorities now are available.

The Week In Engineering and Construction

(*Continued on page* 116)

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Controlled Access Highways

Sir: The writer was interested in your editorial of May 31, vol. p. 756, commenting on the suggestion of H. O. Schermerhorn of the New York State Department of Public Works that highways presently designated as "freeway", "expressway", "superhighway", etc., should be called "controlled-access highways". I might say that the Province of Ontario made this our official designation at the last session of the legislature in March, 1945. We adopted the term "controlled access" on the suggestion of our legal department that it most clearly defined the purpose for which the road was intended. We had previously referred to highways of this type as "divided highways" or "limited-access highways" and the legal office objected to the use of the word "limited" as prejudicing the department in arbitration cases by implying that adjacent owners had been denied something which they had previously enjoyed. The term "divided highway" was not correct when dealing with sections of road which had no central boulevard.

I thought you might be interested in the fact that we have come to the same conclusion as Mr. Shermerhorn and I believe it would be advantageous if the designation "controlled-access highway" could be made uniform throughout the entire North American continent.

J. D. Millar
Deputy Minister,
Ontario Department of Highways,
Toronto, Ont.

Electrode Acceptance Tests

Sir: Industry in general, and the welding industry in particular, are and have been greatly handicapped by the lack of real technical standard covering electrodes. True it is, there has been in existence for some years a so-called standard which actually might be termed a "buyers' guide", known as "Tentative Specifications for Iron and Steel Arc Welding Electrodes" published by the A.W.S. However, even in this long and complicated "buyers' guide" there are so many discrepancies with ambiguous and contradictory statements that it is rendered entirely unsatisfactory. Let me cite a few examples.

To qualify any electrode for any classification, the tests are so complicated and so costly as to render them useless in manufacturing practice. They are too costly to be repeated periodically as a check on manufacturing standards. These are required on all sizes of $\frac{5}{32}$ in. and above; but note—no tests are required on $\frac{1}{8}$ in. and smaller, so why have tests on *each* larger size? A manufacturer cannot use the same electrode for two or more classifications; this in spite of the fact that the ideal electrode, of course, is one which would fulfill all classifications.

Then there are specifications as to the electrical resistance of the coating which certainly has nothing to do with the performance of the electrode. Also it says: "The coating shall not have scabs, blisters, abnormal pockmarks, bruises or other surface defects that shall be injurious." Just what is injurious?

These are only a few of the idiosyncrasies of this "buyers' guide". Therefore, it can readily be seen that what is needed is a simple, easily understandable standard which would enable a manufacturer to manufacture to such standards consistently, and would enable the purchaser to readily and easily test the electrodes if he wished to do so, to see if the manufacturer was conforming to standards.

Since there is no need for a weld stronger or better than the material to be welded, I suggest for mild steel, which covers 90 percent of the requirements, a simple standard something as follows:—The electrode shall be of such characteristics that it will withstand the following tests to be made any time a buyer might desire:—(a)—A weld made in $\frac{3}{8}''$ or $\frac{1}{2}''$ plate of mild steel, planed to the same thickness as the parent metal, must break outside of the weld when pulled in a standard tension machine. (b)—On a section from the same plate mentioned in (a), welds to be bent in any way desired and elongation of 25% in the outside fibers must show no fracture.

It is quite evident that an electrode which will perform as indicated in these two tests will give a weld equal in physical qualities to the plate. With such a weld obviously the matter of porosity is of no consequence. However, if it should be desired to cover the question of porosity, a simple test could be made as follows:—A fracture shall be made through the weld. On a straight line through the fractured weld there shall be voids of no more than 5% cumulatively.

There is no question but that an electrode which will withstand the above very simple tests will be satisfactory in welding mild steel, so why complicate matters.

J. F. Lincoln
President, The Lincoln Electric Co.,
Cleveland, Ohio

Public Works Engineering

Sir: In my opinion, the article by P. L. Brockway entitled "This Business of City Engineering" (*ENR* May 17, vol. p. 720) is one of the most important in its field that I have ever had the pleasure of reading. I don't believe anyone else has ever summed up the problems and conduct requirements of an engineer in public work in nearly such a clear and concise manner.

The contents of this article could well serve as the rule and guide for all engineers whose duty it is to deal with the public.

In the ordinary engineering education we grow to expect far too much of people and depend to too large an extent upon the answers obtained by application of mathematical formulas. Mr. Brockway's article stresses the necessity for humanity as part of the equipment of a successful public works engineer, even of greater importance, in many cases, than technical perfection.

Leo M. Odom
Chief Engineer
State Dept. of Public Works
Baton Rouge, La.

EDITORIALS

VOLUME 135 NUMBER 4

July 26, 1945

First Europe, Now the Pacific

PUBLICATION IN THIS ISSUE of the last of the series of articles on American military engineering in Europe comes by coincidence at the same time that we are able to announce that similar coverage is in store for current Army Engineer and Navy Seabee activities in the Western Pacific and the Philippines. Harold W. Richardson, of *News-Record's* editorial staff left San Francisco last week on an assignment with that objective. His reports will supplement those written from the Southwest Pacific in 1944 by Nathan A. Bowers, and thus will round out the story of the Japanese war. In Europe, civil engineers and construction men in Army and Navy uniforms added immeasurably to America's prestige and to the advancement of technical knowledge in the fields of port repair, bridge reconstruction and airbase building, among many others. These same contributions and additional ones relating to the peculiarities of amphibious warfare are being made in the Pacific. Both as technical developments and as proud achievements of civil engineers and construction men they deserve to be remembered. It is to make this possible that *News-Record's* war correspondent assignments have been undertaken.

News of War Inventions

BECAUSE hitherto secret war developments may readily have important peacetime applications, it is good news that President Truman has vested in the Director of War Mobilization and Reconversion the authority for releasing to the public technical and scientific data previously withheld on the ground of military security. It is to be hoped that the director and his Army and Navy advisers will take this assignment seriously, and not put too strict an interpretation on "military security". Already the British have released detailed news on such developments of theirs as the English Channel pipelines, the use of burning oil to dispel fogs over airbases, the artificial harbors set up on the Normandy coast, military bridges of several types and a number of other wartime inventions. One of the few comparable American developments, so far released, are the great floating drydocks of the Navy, and the news on this was held long beyond any possible security limit. In numerous instances both the Germans and the Japs knew of our military inventions long before the American people did, which may not have made any difference up to the present since there was no opportunity to use the ideas in peacetime work. Now, however, the situation is changed, and free access to information on scientific discoveries of the war period is important just as soon as military security can be removed. That is why it is good news that high authority is taking an interest in the subject.

Reserve Judgment

AT LEAST FOUR INVESTIGATIONS of expenditures by the Army Engineers on the ill-fated Inter-American Highway are now underway, partly as a result of charges by Fulton Lewis, Jr., radio commentator, that vast sums of money were wasted on that work. It will be weeks before the testimony is in and can be appraised, and in the meantime it is incumbent on engineers generally to reserve judgment on the accuracy of the charges. So far, Mr. Lewis has concentrated on exposing everything that appeared to indicate waste and negligence, but has given his listeners none of the related information that is needed to evaluate properly his apparently damaging exposures. The latter information the Army Engineers are now in the process of presenting before a Senate committee. Even at this early date it begins to appear that the Army Engineers were ordered to undertake a task involving great difficulties even in peacetime, presumably by no less authority than the President, and yet were given almost no priorities with which to hire men or to get materials and equipment to Central America. Waste, under such circumstances, was inevitable. Whether there was negligence, inefficiency or bungling is something for the investigators to determine. In the meantime, it is only fair to reserve judgment.

Build Them in Peacetime

TESTIMONY before the Senate committee investigating army work on the Inter-American Highway constitutes the strongest possible argument in favor of the utmost conservatism in embarking on emergency war construction jobs to the end that none is undertaken that is unnecessary or impossible of accomplishment. That the road to the Panama Canal would not be necessary in this war was, of course, not predictable. That it could never be built in time even if it were necessary was the belief of many, including, one suspects, the Corps of Engineers and, as the record shows, this journal, which first urged and then welcomed the abandonment of the project. In looking back at mistakes, however, one should not forget nor fail to appreciate the tremendous load of responsibility that is thrust upon those who must make decisions affecting the safety of the country and the lives of its citizens. No means of reducing this load should be overlooked. One way is to make fewer decisions necessary, and a key to this objective is to build more of our military defenses in peacetime—or decide definitely not to build them at all. Failure to do this in the past rests partly on the twin doorsteps of the Army and the Navy, partly on executive leadership and partly on Congress for refusing appropriations. If we need the Inter-American Highway for defense, let's build it. If we need extra locks at Panama, airbases in the Pacific and Caribbean, coastal waterways, new railroad and highway connections to our Navy yards, let's build them. But do it in peacetime, so that they will be ready if war comes, and so that the tremendous waste entailed in emergency construction can be avoided.

Missouri Valley Planning

WHETHER OR NOT there will be a Missouri River Authority will be affected by the outcome of current meetings of interested governmental agencies under the auspices of the Federal Inter-Agency River Basin Committee (*ENR* July 19, vol. p. 69). If the groups present a coordinated program for development of the Missouri River basin, it is likely that most of the principal arguments of the proponents of an MVA will lose their force. Such a program, however, must be conceived and presented as a working agreement to be adhered to conscientiously and not as a mere emergency plan to be honored as much in the breach as in the observance. The Missouri basin is too large and its orderly economic development too vital to leave its future to any such loose arrangement. Since coordinated action of existing federal agencies is much to be preferred over a centralized super authority, it is to be hoped that the present meetings produce the necessary working agreement to make such a solution possible.

Crusade For Pollution Control

WHILE it was a foregone conclusion that the early postwar period would see renewed emphasis on stream pollution abatement, it has been generally believed that this would emanate primarily as the result of federal compulsion, legislation for which has been under consideration by the Congress for the past decade. It is gratifying to note, therefore, that a crusade for pollution curtailment has already gotten under way without federal impetus, and that it is gathering momentum from widely separated parts of the country.

Tangible evidence of substantial progress is revealed in the round-up of developments published in *ENR* July 12, vol. p. 17. Here we learn that the Pennsylvania Sanitary Water Board has pressed its vigorous campaign begun last year to the point where some 300 municipalities are now under state orders to design sewage treatment works. And in Washington a newly organized state pollution control commission has cited 55 cities to provide immediate attention to unsatisfactory sewage disposal facilities. Meantime, Indiana's governor has issued a novel proclamation calling for all the state to observe Aug. 13-20 as "Stream Improvement Week" and urging citizens to change their attitude of apathy to one of action in regard to pollution abatement. Finally, in North Carolina, a 16-man commission representing the state, industrial and public interests has just been appointed to activate pollution remedial measures.

All of this reveals the vitalizing influence of public opinion at work, and it does great credit to state public health authorities who are giving leadership to this crusade. This does not imply, however, that federal legislation may be unnecessary. We believe that stream pollution is a national problem, certain aspects of which call for federal cooperation. But we also recognize that for pollution abatement measures to be successfully executed, there can be no substitute for local and state action.

That such action will not be lacking is our interpretation of the developments cited. And it is eminently fitting that in bringing strong pressure now for stream pollution abatement many communities will be provided with a tangible incentive for the immediate design of postwar sewage treatment facilities.

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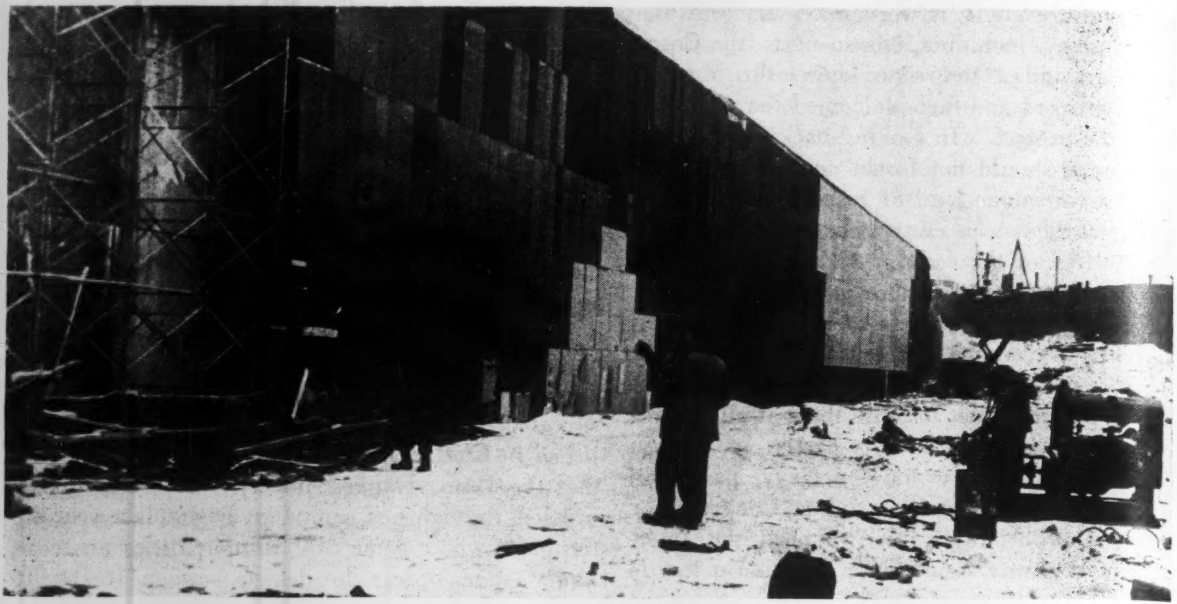

Fig. 1. Insulation board mounted on tubular steel scaffoldingprotected the new concrete canal wall at the Soo.

Wintertime Concreting at the Soo

Contents in Brief—*Modern methods of cold-weather concreting employed last winter in the construction of an 878-ft. long concrete facing wall along an approach canal to the MacArthur Lock at Sault Ste. Marie, Mich., paid big dividends in time saved and results accomplished. By completely enclosing the wall in a weatherproof housing supported by tubular steel scaffolding the contractor was able to complete the job in the dead of winter despite sub-zero temperatures and heavy snowfalls.*

NOT A MINUTE WAS LOST on account of bad weather last winter during a concrete construction job at the Soo despite temperatures that ranged to 24 deg. below zero and a snowfall aggregating some 90 in. This unusual accomplishment is attributed to the meticulous care with which all phases of the work were planned.

Basically, the job involved the construction of a concrete facing wall 878 ft. long, 39 ft. high and from 5 to 6½ ft. thick, along the south side of the upstream approach canal to the MacArthur Lock, which was completed in 1943 (*ENR* Nov. 18, 1943, vol. p. 738). Before the concrete could be placed, however, it was necessary to blast a vertical face in the old Potsdam sandstone forming the canal wall. This roughly quarried rock wall had stood virtually undisturbed since the original canal was excavated, about 92 years ago.

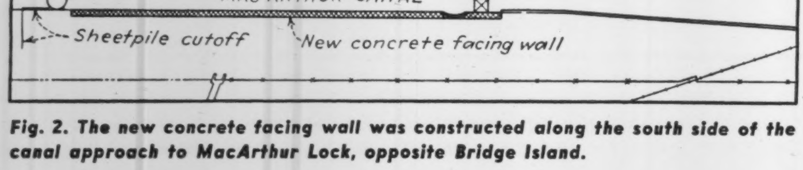

Fig. 2. The new concrete facing wall was constructed along the south side of the canal approach to MacArthur Lock, opposite Bridge Island.

Construction of temporary office buildings and other plant erection was started on this $954,000 U. S. Army Engineer project Oct. 1, 1944. Real construction work started one month later when the south draw of the approach canal to the MacArthur Lock was closed to marine traffic. Work was prosecuted vigorously six days a week, two 8-hr. shifts a day by some 400 construction men and 23 engineer employees.

Fully cognizant of the magnitude of the work which lay ahead—the necessity for speedy construction to complete the job before resumption of lake traffic through the locks in the spring, and the hazards of wintertime concreting in this region—the contractor spared no effort in providing ample construction equipment and establishing an efficient schedule of operations.

Entire Wall Enclosed

Although the project involved several interesting construction features, that of protecting the concrete from freezing is of singular interest due to the great length and height of the new wall. Unlike many construction jobs where each concrete pour is housed and heated only during the curing period, with the housing being moved and reused as the work progresses, this project involved completely housing the entire 878 lin. ft. of wall.

Moreover, it was necessary to erect 900 lin. ft. of self-supporting, steel tubular scaffolding about 40 ft. high along the face of the wall to support the insulating board enclosing the work, and to serve as a working scaffold for building forms for the concrete.

A timber roof was built over the entire length of new wall, supported on the tubular scaffolding and the undisturbed canal bank behind the wall. Removable sections in the roof permitted panel forms to be lifted out by derrick and moved forward as the work progressed. Concrete was placed, in general, directly in the forms through "elephant trunk" discharge pipes attached to hoppers set in openings provided in the roof.

The final major innovation in this elaborate setup was a sawdust-filled timber box conduit extending the full length of the job and containing a 6-in. steam line for heating the concrete. A 2-in. water line and a 6-in. compressed air line required on the job also were installed in the box conduit to prevent their freezing. Convenient outlets were provided at 60-ft. intervals in all three of these service lines.

Improved navigation

Chief purpose of this U. S. Army Engineer construction project was to provide an improved and more efficient canal approach to the MacArthur Lock. Prior to 1943 the larger boats were routed through the Davis and Sabin locks, which are serviced through another canal located to the north. But after the MacArthur Lock was placed in operation most of the deep-draft vessels were dispatched through it.

As originally excavated back in 1853 the old south wall of the south canal had been roughly quarried, which in itself was a hazard to boats scraping against it. Moreover, the old wall sloped in considerably conforming somewhat to the shape of the old whaleback boats used in those days. But this created an additional hazard to present day straight-sided cargo vessels. Primarily, it was to correct these hazards to navigation that the old rock wall was close drilled and broached to a vertical face and a new concrete facing wall added.

The downstream end of the new wall is located about 2,000 ft. above the MacArthur Lock and opposite Bridge Island, which separates the approach canals leading to the MacArthur and the Poe locks. The upstream end of the wall lies about 100 ft. above the end of Bridge Island. Just below Bridge Island the two approach canals merge into one large channel about 300 ft. wide.

In view of this arrangement it was necessary to seal off both canal approaches in order that all work could be done in the dry. The Poe Lock canal was bulkheaded by closing two guard gates located about midway of Bridge Island and by closing an old movable dam pivoted on the island.

To seal off the other channel, 224 lin. ft. of cellular steel sheetpiling cofferdam was constructed between the upper end of Bridge Island and the south bank of the canal just above the upstream end of the new wall. After the canals had been bulkheaded in this manner, upper gates of both locks were opened and the entire area drained to the elevation of the low water below the locks. Upper gates then were closed and the water above the locks was pumped down another 8 ft. to completely dewater the construction site.

Several pumps were required. One 16-in. and two 12-in. electric centrifugal pumps installed in a pump house along the north bank of the 300-ft. wide channel dewatered the site and removed all subsequent seepage entering the area. They discharged into the adjacent canal lead-

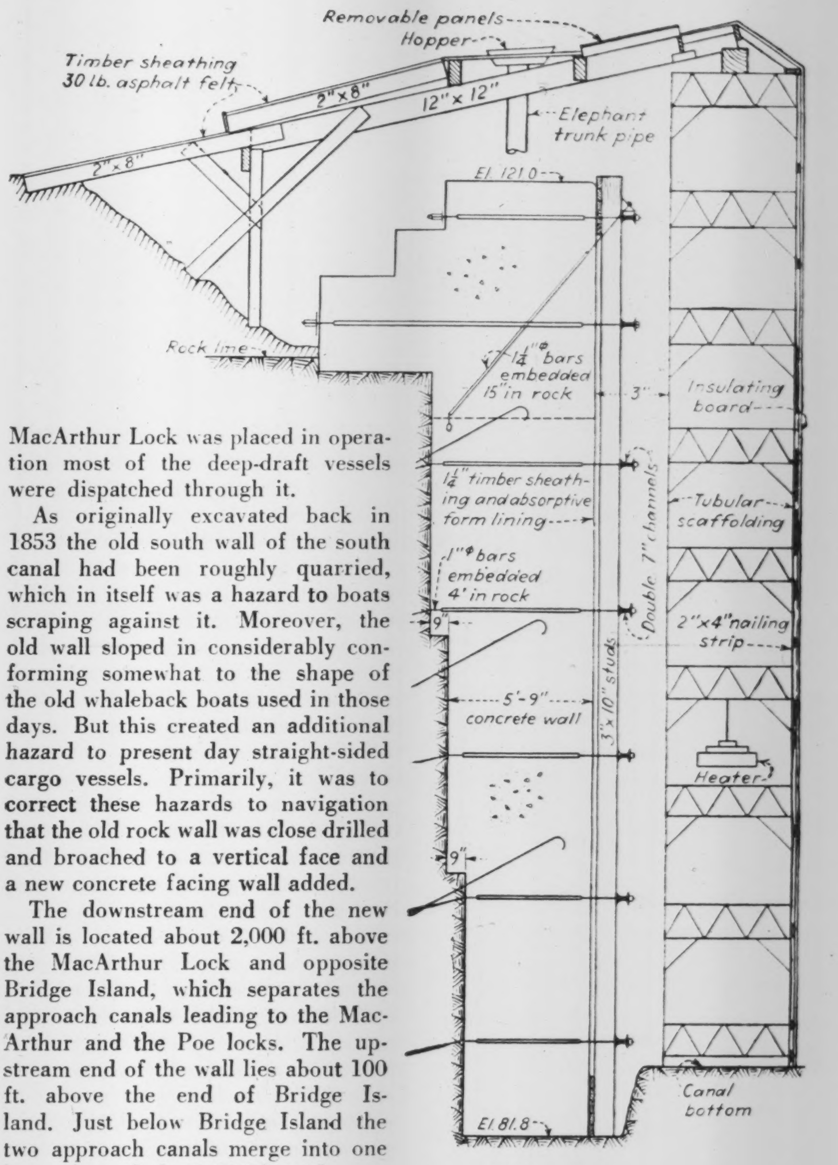

Fig. 3. Tubular steel scaffolding served a triple purpose—continuous support for the timber framed roof, working platform for erecting concrete forms, and framework for mounting the insulating board housing.

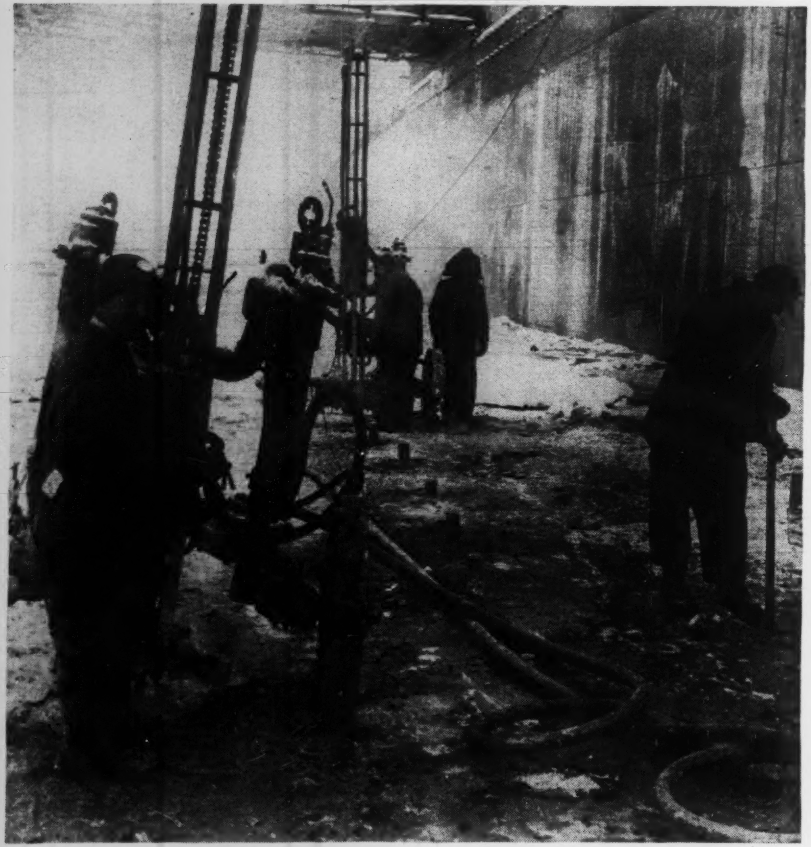

Fig. 4. Wagon drills, modified to permit drilling close to a vertical face, were used to deepen the canal, by drilling and broaching the old rock wall of the canal.

ing to the Davis and Sabin locks. In addition, two 8-in. and one 6-in. portable gasoline-driven centrifugal pumps were needed for incidental pumping and to control the seepage adjacent to Bridge Island and the cofferdam.

Bulkheading the canals

Sealing the upper end of the MacArthur Lock approach canal was no easy job. Construction of the 224 lin. ft. of cellular cofferdam posed no unusual problem; a 5-ft. blanket of clay for anchoring the bottom of the sheetpiling was deposited over the area by a bottom-dump barge, 35-ft. steel sheetpiling were driven in about 30 ft. of water to form the five cells, which were then filled with bank-run gravel, and a 14-ft. high berm was deposited on the downstream side to add stability against sliding. A similar berm of fine material was placed on the upstream side to reduce seepage. The two end cells were circular, 38 ft. in diameter, and the three interior ones were elliptical, 48 ft. long by 40 ft. wide. It took 6,000 cu. yd. of clay to make the bottom seal and anchor for the piling and 14,000 cu. yd. of gravel to fill the cells.

But the real difficulty lay in bulkheading through between abutting ends of 36-ft. wide rock-filled timber cribs forming the canal wall immediately upstream from the end of the new wall. To make this seal steel sheetpiling was driven along the face of the old crib for a distance of 75 ft. upstream from the shoreward end of the cofferdam. At that point a line of sheetpiling was driven through between the ends of two cribs and back into the bank a distance of 86 ft. from the face of the canal.

Considerable difficulty was experienced in removing the rock fill from between the ends of the rock-filled cribs, requiring much underwater work. A tight seal was made at the lower end of this installation by connecting the sheetpiling seal wall to the end cell of the cofferdam by means of a tee section. A similar seal was made to some sheetpiling driven around the upper end of Bridge Island. In addition, an extensive sand-clay fill was required on both sides of the piling behind the crib wall to block off the water from the St. Marys Falls canal, which percolated through the pervious canal bank upstream and adjacent to the piling. The cofferdam and sheetpiling cut-off were completed by Nov. 22, 1944, when arrangements were made for dewatering the area.

Drilling and broaching

Drilling and broaching of the old rock channel wall began as soon as the cofferdam and sheetpiling seal were in place and the area dewatered. First, however, it was necessary to blast off an old 8-ft. deep by 11-ft. wide concrete cap forming the top of the canal wall. Since the rock wall ranged from 30 to 34 ft. in height it was necessary to close drill and broach it in three steps. Six wagon drills employed for this work were modified to permit drilling within 9 in. of a vertical face by setting the drill out in front of the vertical guide frame. The first line of broaching holes were drilled 6 ft. 6 in. back from the established front face of the new wall, which also was about the same distance from the face of the old rock wall. Holes were drilled about 8 ft. deep or one-third the height of the wall and all rock in front was blasted into the canal.

The second line of broaching holes were offset 9 in. in front of the vertical face of rock established by the first blasting operation, while the third row of holes was offset an additional 9 in. and extended 3 ft. below the floor of the channel to complete the operation. Removal of this rock provided space to construct the new wall, which was 5 ft. thick at the bottom, 5 ft. 9 in. thick at the center and 6 ft. 6 in. at the top of the rock.

Rock cut loose before blasting

In general, all holes for broaching were drilled 5 in. apart and 3 in. in diameter, with the intervening 2 in. of rock being split with a broaching tool prior to blasting. Holes for blasting were drilled about 12 in. in front of the broaching holes. They were spaced from 3 to 4 ft. apart and loaded with from one-half to one pound of 60-percent high-velocity gelatin dynamite per cubic yard of blasted rock.

A small deck load usually was placed about 4 ft. above the bottom of the holes to facilitate the blasting. The remainder of the charge was placed at the bottom of the hole.

A complete blacksmith shop, set up on the job to sharpen drill bits for the pneumatic hand drills and wagon drills, and to make spot repairs to the power equipment, paid big dividends in the successful prosecution of the work. Compressed air for drilling was furnished by three 700, two 315 and one 420-cu. ft. per min. capacity portable diesel compressors. A 5-ft. dia. by 13-ft. long receiving tank connected on the line insured a continuous and uniform air pressure.

No secondary shooting of the rock was necessary. It was blasted into the old canal, loaded by steam shovel and trucked by a fleet of ten 3-cu. yd. trucks to a spoil dump established on a vacant area in Sault Ste. Marie. About 20,000 cu. yd. of rock excavation were removed on the entire job and there were about 3,300 sq. yd. of line drilling and broaching.

Timber ramp and stairs

There was no way in which to get power equipment into the old canal or to truck the rock excavation out except by ramp. Accordingly, one was built 453 ft. long, adjacent to the south wall of the canal and on an 8-percent grade. It was of timber construction throughout except for two lines of 24-in. rolled steel beam stringers. Timber bents braced both transversely and tied together longitudinally in alternate pairs were set on mud sills on the bottom of the canal. They carried a 12x12-in. timber cap to support the stringers, which, in turn, carried a 10½-ft. timber plank roadway and a 2½-ft. sidewalk complete with handrail.

One unusual feature of the ramp construction was that 1-in. cracks were left between the flooring pieces, which permitted snow to filter through. None of the snow had to be removed from the deck of the ramp. Another feature of the job was the construction of a 39-ft. high timber stairway leading from the top of the bank to the floor of the channel for workmen entering and leaving the canal.

Several hundred feet of holes also were drilled into the broached face of the rock. Into these were embedded anchors for the new wall and ties for the concrete forms. Three horizontal rows of 1¼-in. reinforcing bars spaced 10 ft. apart were grouted 15 ft. into the old rock and embedded in the concrete wall. Holes were drilled on a 30-deg. angle with the horizontal to insure the anchor rods engaging several layers of the laminated sandstone.

Five horizontal rows of holes also were drilled 4 ft. into the rock, on a 15-deg. angle, to provide anchorage for the concrete forms. One-inch rods were embedded in these holes, which were spaced 5 ft. apart. Rods were bent and extended horizontally into the new wall. Their outer ends were screwed into a pipe sleeve which, in turn, connected to a short length of bolt extending through the outer face of the wall to engage the wales holding the concrete forms in place. Upon removal of the forms these short bolts were turned out and the holes filled with mortar.

Forms for the concrete were made of 1¼-in. T. & G. timber sheathing inside of 3x10-in. vertical studs spaced 16 in. apart and horizontal double 7-in. steel channels spaced 6 ft. vertically. Forms for the first two pours in each monolith were made in panels 16 ft. wide and 30 ft. high. Eight such panels were made and they were picked up by a crawler type derrick and moved forward for reuse as the work progressed. The derrick operated along the canal bank, lifting the forms through holes provided by removable sections in the roof over the wall. The forms for the upper, or third pour of the monoliths also were made in panel form.

Absorptive form lining

An absorptive type form lining was placed inside the sheathing for all exposed vertical concrete faces to increase their resistance to abrasion and to provide against deterioration from alternate freezing and thawing temperatures. The lining was a porous paperboard faced with a ply of lightweight cotton sheeting. It came in 4x4-ft. sheets, which were mounted on the timber concrete forms with a rapid-fire staple gun.

Because of the relatively high humidity inside the forms and the method of mounting the form lining, extra care was required to prevent its buckling after being fastened in place. Where the staples were evenly spaced, however, and sufficient in number the

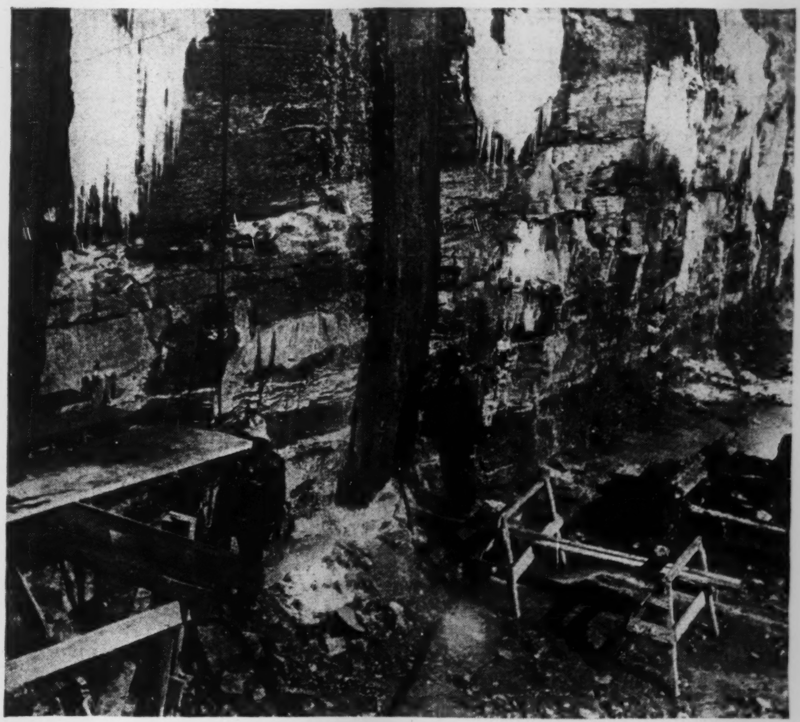

Fig. 5. Additional canal width was provided by drilling and blasting the original rock walls of Bridge Island to a vertical plane. Canvas strips afforded some protection to workmen from seepage through the old laminated rock.

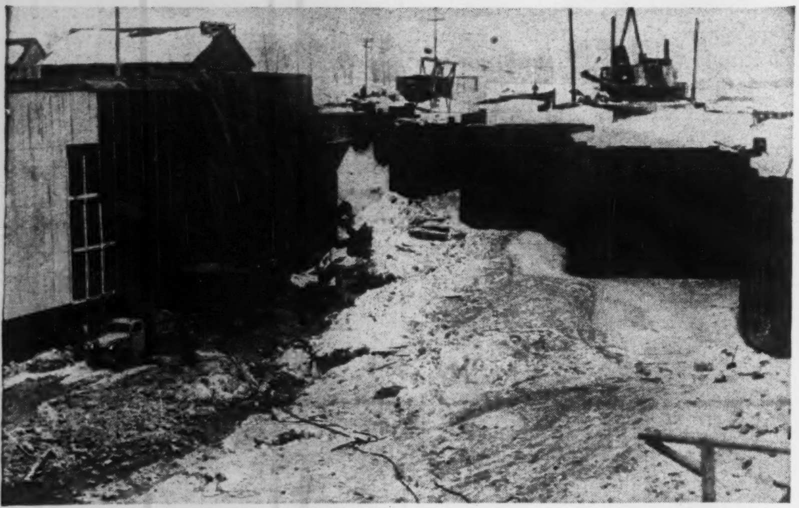

Fig. 6. Steel sheetpile cells filled with gravel and anchored in clay on solid rock formed the cofferdam across the upstream end of the canal.

bulges were small enough to be flattened by the pressure of the fresh concrete. Near the top of each lift it was found best to space the staples 4 in. apart instead of the recommended 6-in. spacing further down.

Another technique used for alleviating this buckling condition was to remove the sheets of form liner from their moisture-proof packing crates a few hours before mounting and allowing them to stand inside the form housing so as to pre-condition them to the humid atmosphere prior to mounting. Adequate vibration of the concrete was found necessary to secure the best results with the absorptive form lining.

Tubular steel scaffolding

The tubular steel scaffolding that supported the insulating board housing was set 3 ft. away from the new concrete walls to provide ample room for erecting and moving the forms. It came in braced panels, 5 ft. wide, and either 5 ft. or 6 ft. 4 in. high. Flanged erection pins inserted in the two hollow pipes at the top of each panel extended up into the next panel to pin them together. The scaffolding was spaced 7 ft. longitudinally and securely cross-braced with small angles bolted to the vertical pipe.

Securing sufficient insulating board covering for the 900-ft. long by 45-ft. high enclosing structure was quite a problem. Both asphalt impregnated and plain types were used. It came in 2x8-ft. and 4x8-ft. pieces, either ½ or ¾ in. thick. It was fastened to longitudinal 2x4-in. timber nailing strips spaced 4 ft. apart vertically and wired to the outside of the tubular scaffolding.

A considerable portion of the insulating board was salvaged in good condition after it had served its purpose. According to the contractor, the ¾-in. thick T. & G., 2x8-ft. pieces of board proved the best since it required less nailing and less labor both to install and to remove.

Functional timber roof

Considerable attention was given to the arrangement and construction of the timber roof since it had quite a span and the orderly prosecution of setting forms and placing concrete depended on its layout. Its chief structural members included 900 lin. ft. of 12x12-in. timber placed on the centerline of the steel scaffolding, and an equal length of 3x12-in. timber securely nailed to 6x12-in. posts set well back on the canal bank, 29 ft. from the centerline of the scaffolding.

Supported transversely on these two longitudinal girders were 12x12-in. by 20-ft. timber rafters spaced alternately 18 ft. and 12 ft. apart, to support the roof. Rafters were built on a slope of 2½ in. per foot, and 2x8-in. by 11-ft. timbers, spaced 2 ft. apart, were extended from the ends of the main rafters to the natural ground surface to complete the roof support.

Extra care was used to make the roof weatherproof, both to keep out rain and snow and to hold in the heat supplied for curing the concrete. The insulating board covering placed on the front face of the scaffolding was continued up to a hip joint about 2 ft. above the centerline of the scaffolding and about 2 ft. down the sloping roof.

At this point, which was directly above the front face of the wall, a 4-ft. width of roof was made removable for its entire length to permit installation and removal of the paneled concrete forms. Adjacent to the removable sections and directly over the new wall, the roof was built almost horizontal for a width of about 6 ft. Hatches with long removable covers 1x2 ft. were installed at about 10-ft. intervals throughout the entire length of this portion of the roof to receive the metal hoppers through which the concrete was poured into the wall.

The remainder of the roof was solid timber sheathing. Rough native lumber was used chiefly for the roofing, covered with an asphaltic felt to make it water resistant.

A system of electric lights was installed inside the housing to provide light during both the day and night shifts. Floodlights also were mounted at strategic points around the canal to permit drilling and blasting during the night shift.

No salamanders were used to heat the fresh concrete, chiefly because of the fire hazard involved. Instead, 17 force-blower steam heaters were employed, each having a rated capacity of 300,000 B.t.u. per hour. They were suspended from the scaffold about 12 ft. from the bottom of the housing and faced downward to force the heat to the bottom. This resulted in a temperature of 50 deg. at the bottom of the housing and 70 deg. under the roof.

Steam for the heaters was furnished by two boilers; one of 125-hp. capacity and one of 80-hp. A third, 80-hp. boiler, was installed in the boiler house and used only as a standby unit in case of an emergency.

Wall built in monoliths

The concrete wall was poured in monoliths 30 ft. long; three pours to each monolith. The first lift was 17 ft. high, the second 13 ft. and the third pour 9 ft. high, which included an irregularly shaped cap 11 ft. wide.

Three continuous pieces of 10x12-in. Georgia swamp oak timber fenders were bolted to the new wall near its top to protect cargo vessels during transit through the canal.

Starting at the downstream end, the wall was constructed by pouring alternate monoliths. The general procedure was to set up panel forms and make the first two pours in monoliths No. 2, 4, 6 and 8, followed by similar pours in monoliths 1, 3, 5 and 7, and so on. The upper section of each monolith was poured in like manner although the construction of forms for this work followed considerably behind removal of the lower forms.

Air-entraining admixture in cement

Some 10,000 cu. yd. of concrete were required to build the 878-ft. facing wall. Air-entraining admixture in the cement was specified for the entire job; the cement used, as recommended by the manufacturer, and as required by the government, contained 0.035-percent vinsol resin.

Transit-mix concrete was delivered to the job at a minimum temperature of 60 deg. by a fleet of six 3-cu. yd. transit mix trucks. There it was dumped into 1-cu. yd. buckets lifted by crane to hoppers set in the roof of the enclosing structure and poured through elephant trunk chutes directly into place. All concrete was compacted thoroughly with mechanical vibrators.

After each of the bottom two pours in a monolith had taken its initial set, all laitance was flushed off with a water hose before making the next pour. The concrete was cured at least five days. Exposed surfaces were given a protective coating of membraneous curing compound as soon as the forms were removed.

The last of the concrete was poured on March 5. Removal of the cofferdam started shortly thereafter and the job was flooded on March 10. In removing the cofferdam, as much of the gravel fill as possible was removed by clamshell and dragline working on top of the cofferdam. The area then was flooded, steel sheet-piling pulled with a floating derrick and the remainder of the clay and gravel fill cleaned out with a floating clamshell dredge.

Other contract items

Other items of the contract included: (1) Vertical channeling by close drilling and broaching the old, irregular rock face along the south wall of Bridge Island in order to improve the channel, (2) deepening the approach canal to the Poe and MacArthur locks in two areas, each 220 ft. long, where they had never been excavated to the required 27-ft. depth below low water, and (3) provision for installing a set of five 106-ft. long structural steel stoplog bulkheads at the upstream entrance to the Poe Lock.

These stoplogs are similar in design and operation to those installed in 1943 above the MacArthur Lock (*ENR* Nov. 18, 1943, vol. p. 738). With these stoplogs assembled on the canal bank and ready to be installed on short notice to shut off the upstream flow into the Poe Lock, together with the previously installed arrangement for protecting the MacArthur Lock, there will be no further need for the 330-ft. span movable dam pivoted on Bridge Island. U. S. Army Engineer plans contemplate its removal sometime during this summer.

A contract for this unusual wintertime construction project was held by the Sunswick Corporation, New York City, a subsidiary of Spencer, White and Prentis of that city. The contractor's supervisory personnel included Edward E. White, manager; Albert Di Giacinto, superintendent of construction and George Flay, engineer. Howard MacDonald is owner and manager of the Soo Gravel Co., Sault Ste. Marie, which furnished the concrete.

All construction at Sault Ste. Marie, Mich., is under the jurisdiction of Col. Allison Miller, district engineer, Detroit District, U. S. Army Engineers. The project was carried out under the direct supervision of J. E. Harns, engineer in charge. C. A. Aune was assistant engineer in charge, Bert G. McCarthy, project engineer and A. A. Joseph, assistant project engineer.

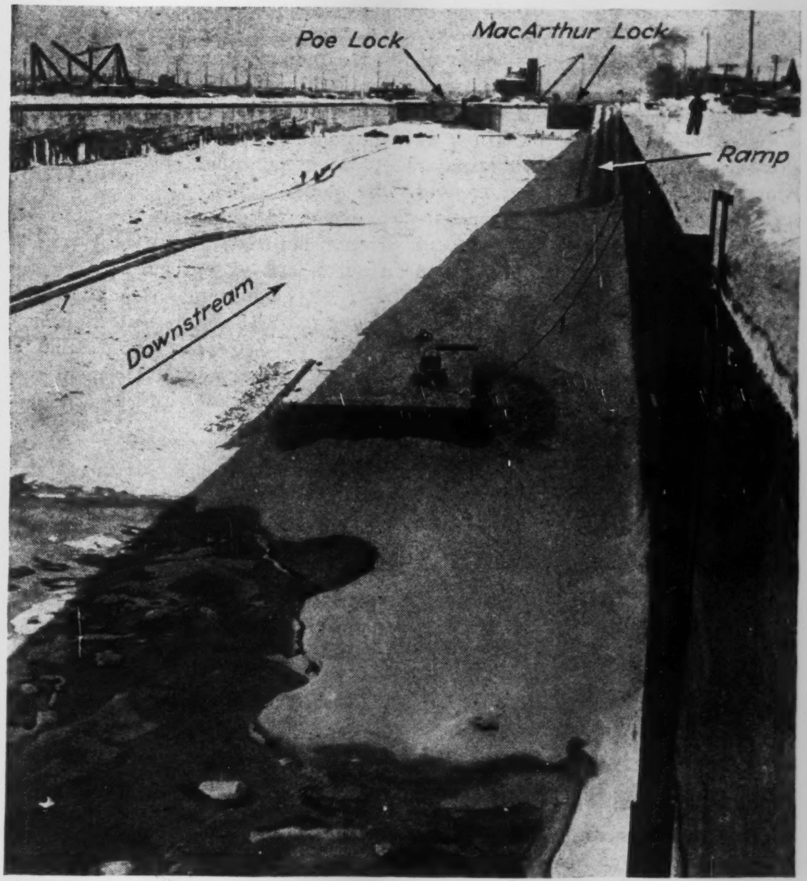

Fig. 7. Looking downstream along the new concrete wall of the approach channel to the Poe and MacArthur locks. All hazards to ships due to the irregular exposed rock on this side of the channel have been eliminated. The ramp shown is the temporary one to give access to the channel.

Natural Cement Blend Improves Concrete

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***Contents in Brief**—A research program using the facilities of the Louisville Cement Co., Louisville, Ky., indicated that substitution of a bag of natural cement, containing an air-entraining agent, for a bag of normal portland cement in a cubic yard mix will improve workability, reduce bleeding, increase watertightness, and yield a tough, acid-resisting and durable concrete. A method of designing a concrete mix using a blend of natural and portland cement is explained.*

IT IS GENERALLY RECOGNIZED that concrete containing from 3 to 6 percent air in the form of microscopic bubbles is highly resistant to freezing and thawing, and to scaling. Early experience with this type of concrete dates back to 1934, when blends of natural cement and portland cement were used experimentally in concrete pavements. A small quantity of grease, or resin, or other similar substance, which had been ground into natural cement during manufacture, resulted in air-entrainment in the concrete. This was a new idea to concrete technicians.

The substitution of a sack of natural cement for a sack of normal portland cement in a cubic yard mix produced concrete having outstanding resistance to scaling in pavement slabs as well as high resistance to freezing and thawing cycles, according to accelerated laboratory tests. Subsequent laboratory and field studies, comparing the properties of concrete made with blends of natural and portland cements with the properties of concrete made with normal portland cement alone, have focused attention on other characteristics of the blend.

These characteristics are: (1) Extreme plasticity, workability, cohesion or lack of segregation (see Fig. 1); (2) minimum of bleeding or water-gain; (3) more watertight concrete; (4) strength comparable to that of normal portland cement concrete, if proper adjustments are made in the mix, as discussed later (see tabulation); (5) tougher, less brittle concrete; (6) resistance to sulphates and certain dilute acids as in sewage and certain industrial wastes; and (7) low heat of hydration.

Later it was demonstrated that concrete having comparable resistance to freezing and thawing, and to scaling, could be produced also by grinding the air-entraining agent directly into the portland cement. However, not all of the advantages of the blend can be secured in this way, because some of them are inherent in natural cement itself.

Both methods of securing air-entrainment in concrete are mentioned in the specifications of several U. S. government departments as well as several state highway departments. A number of city engineers recognize its advantages in structures and mass concrete as well as in pavements.

Blend design simple

It is a simple matter to design a concrete mix using a blend of natural and portland cements. However, the designer who is not familiar with the characteristics of concrete made with the blend should proceed as follows:

First, start with a design for normal portland cement, making a trial batch as a check. Then make a new batch using a blend of portland and natural cements. To do this, alter the established normal portland mix as follows:

1. Substitute natural for normal portland cement on the basis of 80 lb. (1 sack) natural cement for 94 lb. (1 sack) normal portland cement in each cubic yard of concrete.
2. Adjust the sand content downward by 3 to 5 percent of the total weight of aggregates. The sand content should be reduced more in lean mixes than in rich mixes.

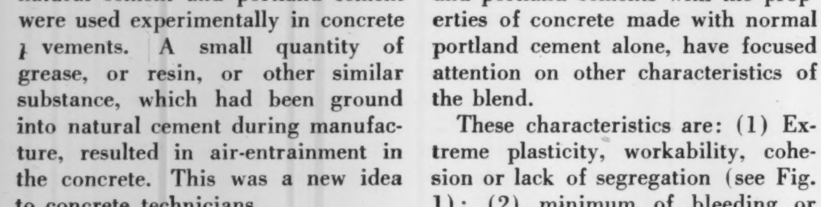


Fig. 1. To compare workability and segregation, two mixes having a slump of 4 in. were prepared. The mix at the left contained one part portland cement, 2.8 parts sand, 4.2 parts gravel and 6.5 gal. water, whereas the one at the right consisted of one part cement (80 percent portland and 20 percent natural), the same quantities of fine and coarse aggregate and 6 gal. water. The latter mix is obviously more cohesive, illustrating why it would be feasible to lower the ratio of fine to coarse aggregate in this mix.

3. Adjust amount of mixing water or water-cement ratio downward enough to give consistency desired under conditions of placement. This adjustment is necessary in order to avoid excessive slump.

Now, the designer is ready to make his final mix. Fine adjustments in proportions can be made. Also, reduction in total weights of aggregates can be made to compensate for increased yield due to air-entrainment. The cubic foot weight of the blend mix as compared with the theoretical cubic foot weight by absolute volume calculations is the basis for this reduction. (Note: After a few trials, using the normal portland cement mix as a starting point, the experienced technician can easily design mixes directly using a blend of normal portland and air-entraining natural cement.)

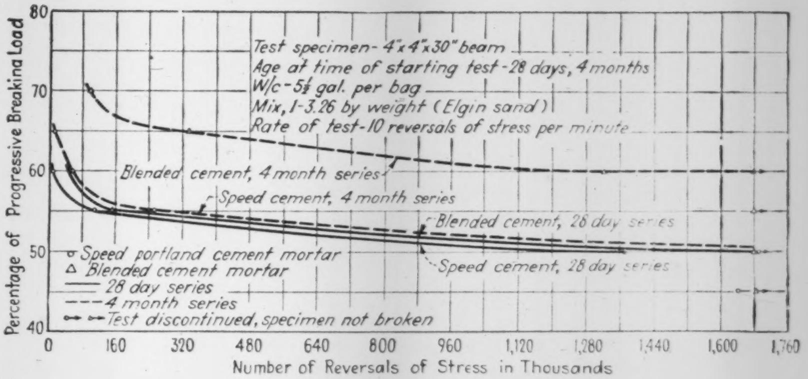


Fig. 2. From fatigue endurance tests of cement mortar beams ("Physical Properties of Speed Portland and Blended Cement Mortars and Concretes," by R. E. Mills and R. B. Crepps, Engineering Experiment Station, Purdue University), it is evident that the fatigue endurance of blended cement is markedly superior to that of straight portland cement.

Natural cement beneficial

The replacement of one sack of portland by one sack of natural cement is recommended, whether the mix be lean or rich. Natural cement contributes a large measure of workability because of its air-entrainment feature, its greater fineness of grind, and its inherent plasticity. A one bag replacement in a lean mix may amount to as much as 25 percent of the total cement, and it is in the leaner mixes where the benefits derived from the use of natural cement not only are more apparent but more needed.

The one bag replacement in the rich mixes will amount to approximately 15 percent. This is a sufficiently high percentage to give proper air-entrainment and the other properties of natural cement to the extent required in rich mixes. Thus, it is logical to reduce the sand content more in lean than in rich mixes, when the blend is compared to normal portland.

In the accompanying table are given the results of using the steps mentioned above in design of the mixes. These results are readily reproducible. In this table, the blend mix has not been redesigned to compensate for increased yield due to air-entrainment. Specific gravity of sand has been taken as 2.65 and of gravel as 2.70. Test specimens were 6 x 12-in. cylinders, cured in a moist room at 70 deg. F.

By reducing the sand 53 lb. and the gravel 101 lb. in this blend mix, with 3.4 percent air-entrainment, the yield should be one cubic yard, or equal to the yield in the straight portland mix. Under actual field conditions, the adjustment in aggregate weights would probably be calculated on a 2 percent air-entrainment basis in order to assure the contractor of 100 percent yield. The percentage of air-entrainment, generally, cannot be controlled in the field any closer than from 1 to 1½ percent, which is well within the expected accuracy of field concrete.

Air-entrainment a factor

Some of the improvements noted above are undoubtedly due, in whole or in part, to air-entrainment. Just as assuredly, some of them are directly traceable to the presence of natural cement in the mix.

Inherently, natural cement is extremely plastic and workable. In its manufacture, natural cement is not fused or clinkered as is the case with portland cement. For this reason, its particle structure is less glassy and the ground product is considerably finer than that of portland cement.

This combination of characteristics of natural cement particles results in higher water-retaining capacity that contributes to the reduction in

COMPARISON OF PROPERTIES OF CONCRETE MADE BY USING NORMAL PORTLAND CEMENT AND A BLEND OF 4/5 NORMAL PORTLAND CEMENT AND 1/5 NATURAL CEMENT*

Cement	Quantities for 1 Cu. Yd.						Cu. Ft. Wt. Freshly Mixed Concrete Lb.	Compressive Strength in psi.			
	Sand (dry)		Gravel (dry)		Water (Gal.)	Slump In.		Age 7 Days		Age 28 Days	
	Lb.	Per Cent of Total Aggr. (Abs. Vol.)	Lb.	Per Cent of Total Aggr. (Abs. Vol.)							
5 Bags Portland Cement.......	1316	39	2094	61	31.6	3	153.3	3149 3201	3175	4298 4103 3961	4121
4 Bags Portland Cement.......	1200	35	2252	65	39.0	3	148.7	3089 3183	3136	3979 4351 4103	4144
1 Bag Natural Cement.........	....	..	....	..	....	..	.....				

* Containing air-entraining agent.

bleeding or water-gain of the blend.

Natural cement also contributes elasticity or toughness to concrete as evidenced by increased fatigue resistance and plastic flow properties of hardened blend concrete. The chemical compounds of natural cement generate less heat upon hydration than those of portland cement. This is important in mass concrete.

For many years natural cement has been used for sewer work because of its resistance to the dilute acids contained in sewage wastes.

When natural cement is used as a blend, more accurate control of air-content in concrete is secured than when air-entraining portland cement is used. This is because the quantity of air-entraining agent is fixed in the air-entraining portland cement; whereas, when a blend of natural and normal portland cement is used, the quantity of air-entraining agent in the wet concrete can be controlled by changing, if need be, the percentage of natural cement used in the mix. Subject to accurate control, the air-entrainment feature of the blend gives extreme durability and resistance to scaling in exposed slabs.

Summing up, there is weighty evidence that concrete made from a blend of air-entraining natural cement and normal portland cement is more durable, more plastic and workable, shows less bleeding, is more watertight, tougher and less brittle, is more resistant to sulphates and certain dilute acids, and has lower heat of hydration than concrete made with normal portland cement alone. It is no more difficult to design mixes using the blend than to design mixes using normal portland cement alone.

Timber Bridge on Logging Road Advertizes Product it Transports

Trucking heavy logs from the woods to tidewater, where large log rafts can be made up, is sometimes done in the Northwest on such a scale that it is economical to build private roads over which can be operated trucks with loads far in excess of those permitted by law on the state highways. The Ostrander Lumber Co. has built such a road, some 30 mi. long, in Oregon, over which loads of 100,000 to 120,000 lb. are regularly being hauled.

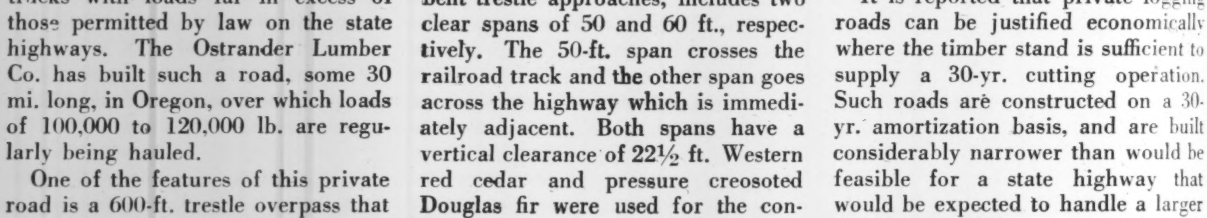
One of the features of this private road is a 600-ft. trestle overpass that spans Route 99-E and the Southern Pacific railroad tracks near Canby. Built of logs, the design and construction are such as to call immediate attention to the service for which it is used.

The bridge, with earthfill and pile-bent trestle approaches, includes two clear spans of 50 and 60 ft., respectively. The 50-ft. span crosses the railroad track and the other span goes across the highway which is immediately adjacent. Both spans have a vertical clearance of 22½ ft. Western red cedar and pressure creosoted Douglas fir were used for the construction.

Although the railing appears to be quite ponderous in relation to the other parts of the bridge, this was a purposeful provision. The guard rail is designed to prevent the possibility of logs in transit falling on the road or railway.

Design of the bridge was based on preliminary sketches furnished by Ward Gano, of the U. S. Forest Service engineering staff.

It is reported that private logging roads can be justified economically where the timber stand is sufficient to supply a 30-yr. cutting operation. Such roads are constructed on a 30-yr. amortization basis, and are built considerably narrower than would be feasible for a state highway that would be expected to handle a larger number of vehicles.



This timber trestle and overpass of novel design is used as a private road for logging operations. Right: construction details of one of the clear spans. The heavy guard rail is designed to prevent logs in transit from dropping over the side.

AN ENGINEERING NEWS-RECORD FOREIGN REPORT

Railroad Bridging in E.T.O.—Part II

Waldo G. Bowman
Editor, Engineering News-Record

Contents in Brief*—The speed with which railway supply lines could be opened from the ports of France to the front lines in the European theater of operations depended upon the skill of our Army Engineer bridge builders. How they handled seven of the most important jobs west of Paris was the theme of Part I of this article, published in the July 12 issue. This week, the concluding chapter is devoted to the procedures used on thirteen other bridges, all but three of which are east and northeast of Paris, including two in Liege, Belgium.*

East of Paris, bridges were longer and lower than those in the west of France, described in the first installment of this article, so that the reconstruction problems there were different. Pile trestles could often be used, the debris and wreckage of the original bridge were frequently available to build on, and beam spans were more often used than UCRB's. Bridges that were interesting or significant for one reason or another were located at Vitry-le-Francois over the Marne, at Toul and Verdun over the Meuse and at Metz and Thionville over the Moselle.

At Vitry-le-Francois our bombers had been lucky enough to get two direct hits while a German train was crossing. Cars and track were tossed in all directions, and when the smoke had cleared two of the three 90-ft. masonry spans were just a pile of stone in the river. Rather than attempt to remove or build through it the Engineers of the 347th Engineer General Service Regiment used the debris to carry wood sills upon which bents were set to support a stringer-type bridge. Two bents set close together were braced into towers, which were spaced 40 ft. apart, while alternating with them were single bents, also 40 ft. apart. Longitudinal x-bracing was used between all bents and towers. The stringer spans, made of 18- and 24-in. captured German I-beams, were welded together and designed as continuous over a series of supports.

One interesting feature of the Vitry-le-Francois bridge is the use

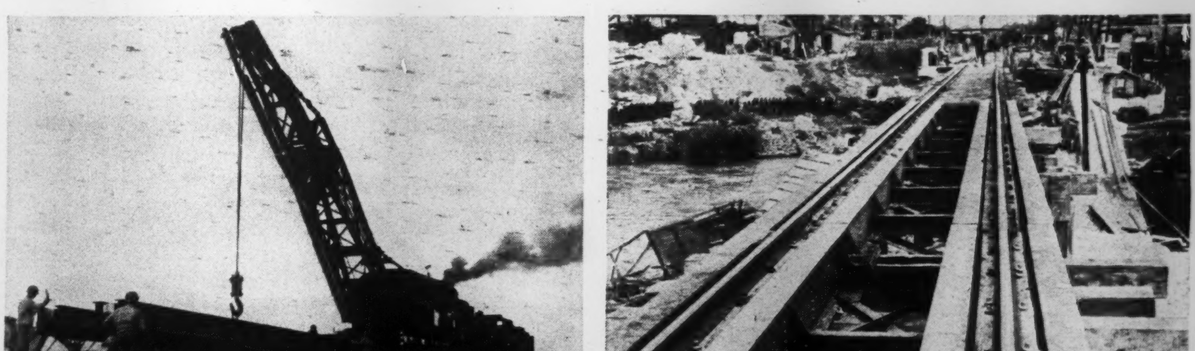


Fig. 13. At Vitry-le-Francois on the Marne, the Engineers set timber bents for a new bridge on the masonry debris of the old (left) and also used a captured prefabricated unit for one of the spans. Note (right) how each rail in this prefabricated unit is fastened to a timber stringer carried between two I-beams.

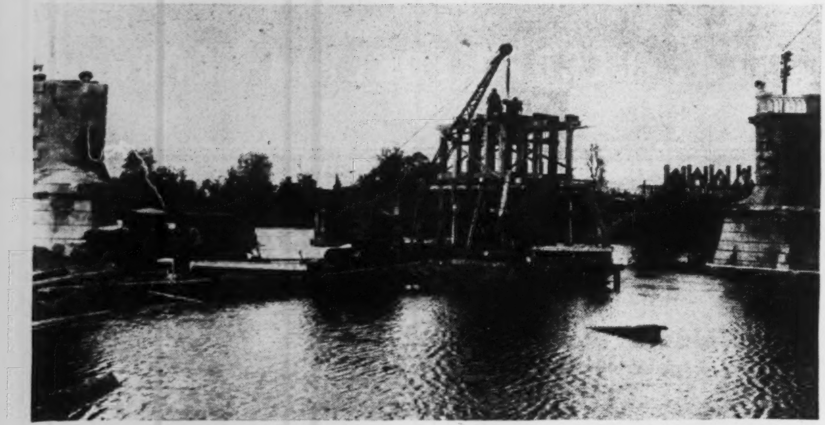


Fig. 14. Two-story preframed timber tower being erected for the Moselle River bridge at Toul. Simple, rigid framing and easily handled erection pieces are advantages of such a design.

for one 40-ft. length of a completely prefabricated deck girder span found in a railroad yard. As shown in the accompanying illustration, each rail of this span is carried on a longitudinal timber sleeper supported on cross members between two rolled beams. Such an arrangement permits shallower construction than does that using a single girder at either side, and it is also more rigid when being lifted by a crane or cantilevered into position.

At Toul, two spans out of a bridge of five 139-ft. steel deck arches had to be replaced with steel beam construction. One opening was over land where foundation construction was simple, so it was divided into three short spans carried on two braced timber bents. The other span, however, was over the river where only one new support was advisable to carry two 70-ft. beam spans. The type of design adopted was a pile base upon which a preframed timber tower in two separate stories was set. The lower story was braced by inclined members, while all posts in the upper story are vertical. (Fig. 14) Framing is simplified and smaller assembled sections are required to be handled by the erecting cranes with this type of support. To aid in the construction of this pier and eliminate the need of floating equipment, an earth causeway was built out to it, since the water was only about 12 ft. deep. The Toul bridge was built by the 341st Engineer General Service Regiment.

UCRB units erected in place

The bridge at Verdun in which three of the five masonry arches were destroyed and replaced by three 70-ft. UCRB's by the 347th Engineer General Service Regiment is important as exemplifying the erection of such spans in place rather than by launching. There was enough rubble in the river to provide support for the falsework as well as a working platform for the erecting cranes. First, a temporary LST pier was set 30-ft. from the permanent pier. A 30-ft chord piece, made of two 15-ft. chord members, bolted together on the ground, and a 40-ft. chord piece of two 20-ft. members, were then lifted and bolted together on the LST pier. Diagonals and top chord members were added, and the LST pier removed. Two spans were built thus, but for the third one the LST pier was dispensed with, and the entire 70-ft. bottom chord lifted into place by two cranes.

Another operation on the Verdun bridge was the job of double tracking, in which the new steelwork was placed by outriggers made of meter beams installed crosswise on a flatcar of the work train, which was operated on the existing track. The beams for the bridge were suspended

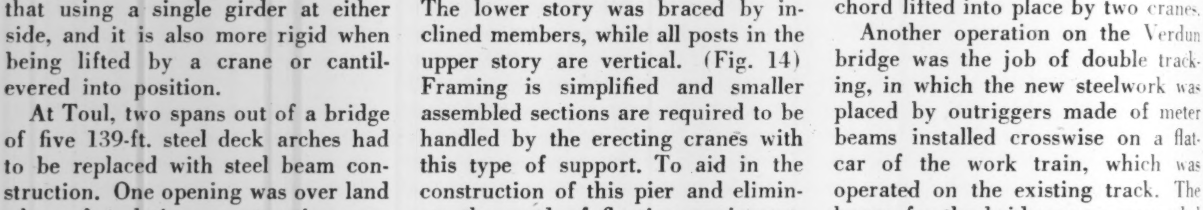


Fig. 15. Engineer-built crane for railroad bridge erection consists of a 95-ft. meter beam mounted on a flatcar. Shown here completing a bridge over a canal at Metz, it was also used on the long Moselle River crossing at that same city.

from these outriggers in the supply yard after which the car was pulled out on the bridge and the beams lowered directly into place.

At Metz, an unusually long masonry structure, 850 ft., was destroyed by demolitions and had to be entirely replaced by meter beam spans on LST towers. Although two of the arches were still standing, steelwork was carried across them, too, as being a quicker method than attempting a repair or removal job. The unusual feature of the Metz bridge was the erection of its meter beam spans by a flat-car-mounted launching derrick devised by the 347th Engineer General Service Regiment and nicknamed the "Long Tom". It consists simply of a 95-ft. meter beam anchored to the car and projecting 50 ft. out in front as a derrick boom (Fig. 15). The beam is trussed top and sides with wire rope strongbacks, and is capable of supporting 12-ton loads. The lifting hook at the end is suspended from a block-and-falls whose 7/8-in. hoist line leads back to a hand winch on the car. In operation, the "Long Tom" can pick up any beam up to 90 ft. in length, be pushed out to the end of the bridge and deposit its load in the next span. Unusual speeds in erection of beam bridges, once the foundations are in, have been attained with this special erecting rig.

First use of Nazi hollow steel piles

The Thionville bridge marked the introduction of hollow steel piling captured from the Germans into our military bridging program. Actually, five separate and parallel through girder structures, this bridge was very badly wrecked by demolitions, and was too heavy to be readily removed. It was decided to build over and through it, disturbing as little of the wreakage as possible (Fig. 16).

The Germans had rebuilt parts of the bridge on several occasions, and had used a special type of hollow steel pile, quantities of which were still lying about. Some of the piles were made from two pieces of deep arch steel sheetpiling fastened together in the interlocks, but others had been manufactured as pipe is made, with one welded seam, and sometimes with two. The piling could be driven through debris, and welded bracing could be installed easily.

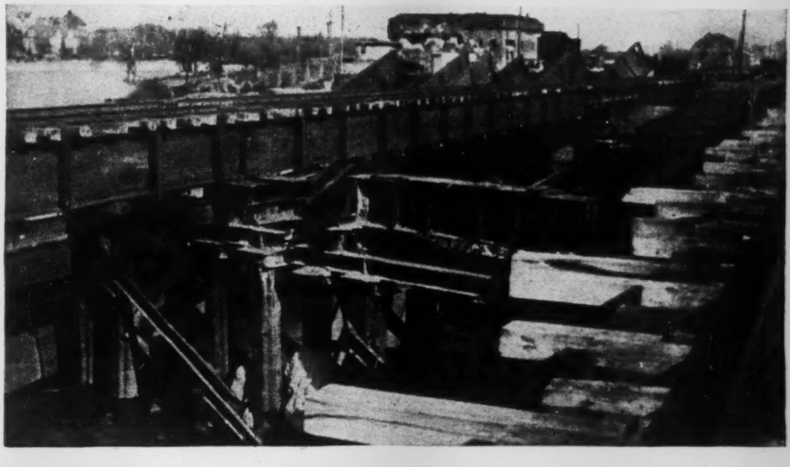


Fig. 16. Meter-beam bridge at Thionville is founded on piers of hollow steel piling captured from the Germans. The vertical channels on the sides of the meter beams are part of the yokes that hold the beams against interior timber spreaders used in lieu of welded or bolted steel sway bracing.

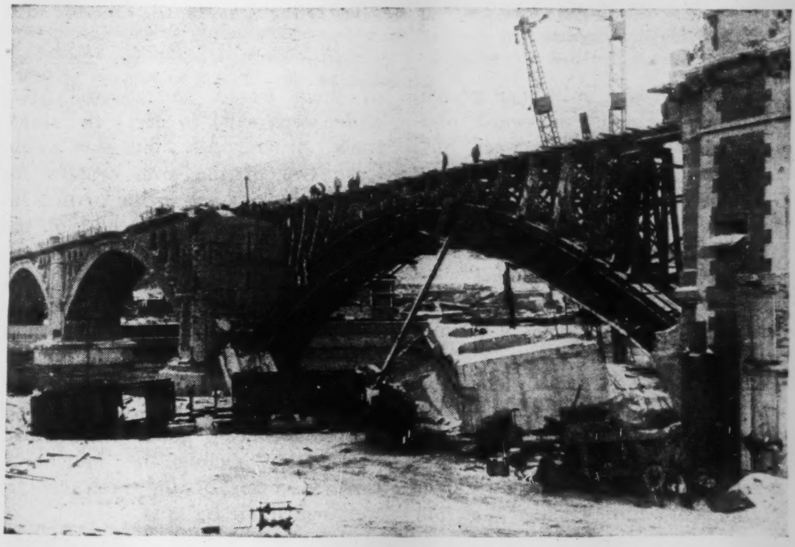


Fig. 17. Steel arch centers originally employed by the contractor in building the 220-ft. concrete arches of the Renory viaduct in Liege are used as load-carrying arches in one of the spans that bombs destroyed. The temporary construction is confined to one track, leaving the other half of the bridge available for permanent rebuilding in concrete.

One of the most spectacular of our bridge jobs occurred when we captured Liege, Belgium, and had as an early assignment the repair of the double track Renory viaduct, a concrete structure of ten 220-ft. arch spans across the Meuse River, one span of which, next to the end on the east side, our bombers had knocked out. To have closed the opening with beam spans would have required two temporary piers of exceptional height since top of the rail elevation was 90 ft. above the water. Means of securing a clear span were, therefore, sought.

The 1053rd Port Construction and Repair Group, which had been given the job, learned that steel arch centers, used in the construction of the concrete arches were still in the yard of the contractor, and immediately proposed the plan of using them as the load-carrying members of the new span. The railroad officials agreed, and the result is an arch that hardly breaks the continuity of appearance of the bridge (Fig. 17), and, more-

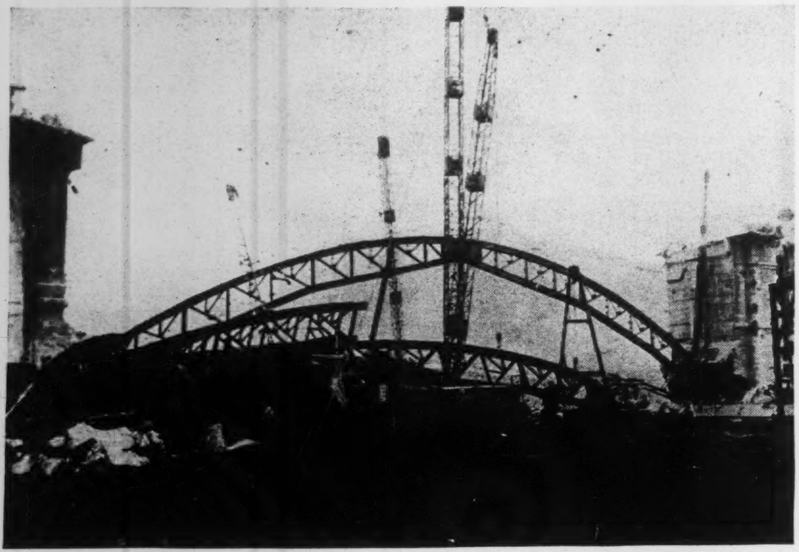


Fig. 18. Derricks raise one of the three-hinged arch centers that were assembled into a steel arch span to close a 220-ft. gap in the ten span Renory concrete arch viaduct at Liege, Belgium.

over, one that was built very expeditiously despite many untoward interruptions, in the period between Nov. 27, 1944 and Jan. 28, 1945.

Although similar arch centers had been used for the original construction of the bridge, 1926-29, the ones that are now being employed were fabricated at the order of the Germans and used by them to rebuild three of the concrete arches that the Belgians had destroyed when their country was invaded in 1940. There were six of the arch centers, two for each of the three spans, and our Engineers, in consultation with the Belgian fabricators, decided that four of them would be required (two under each rail) to carry the single track railroad. Also, this plan would leave two of the arch centers for the Belgians to use in the permanent rebuilding of the other half of the arch while trains continue to use the "arch-center" half.

In redesigning the arch centers to carry E-40 railroad loads, particular care had to be exercised on the detailing of the sway bracing, which required some 45 tons of structural steel in order to get a proper load distribution among the four arch centers. Each of the arch centers weighed about 65 tons.

It was also necessary to replace a horizontal jacking device at the crown, used originally for decentering the arches, with a hinge-pin detail. All field connections were welded. Bents to support the track, which was carried on meter beam stringers, were of 12x12-in. timbers except for the two at each end, which because of their height (23 and 25 ft.) were made of structural steel, 12-in. H-columns and angle bracing.

The erection of the arches was accomplished with the use of 75-ft. guyed steel masts at either end, and an 85-ft. guy derrick on the shore plus a 50-ft. A-frame on a barge. Being three-hinged, the centers could be pinned at their ends and then the two halves raised until the crown hinge pin could be connected (Fig. 18). Belgians supplied the heavier equipment.

Although the job was an exacting and relatively large one, requiring 2,760 ft. of ½-in. field welds, 10,000 bolts, 200 tons of new structural steel and 42,000 b. ft. of timber, it would not have been difficult except for the weather and the Germans. The steel was covered with ice on a good many days, it snowed frequently, and when the "Battle of the Bulge" neared the Meuse River, the Germans bombed the site. Buzz bombs were particularly troublesome, the men 75 ft. above the water naturally feeling that each one was going to land on the bridge.

Bypassing wrecked part of bridge

By blowing one pier the Germans wrecked two spans of a five-span continuous plate girder bridge leading

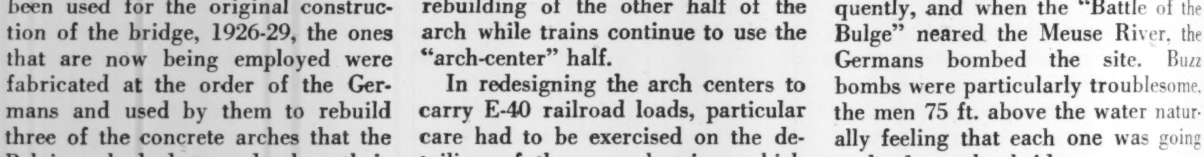


Fig. 19. Too heavy and cumbersome to be moved readily, the two wrecked plate girder spans of the Ile de Monsin bridge over the Meuse at Liege (left) were bypassed by a turnout bridge (right). Pictures are taken from opposite banks of the stream. Note, in left view, how girder shoe is lifted from the pier.

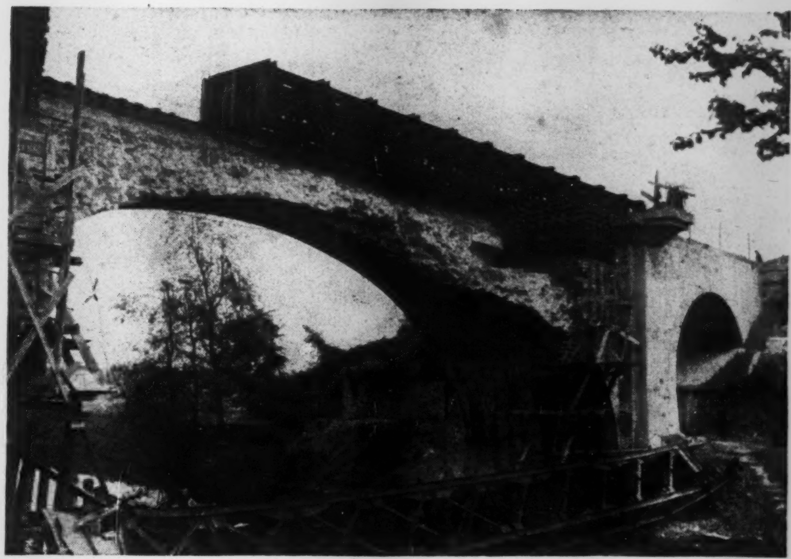


Fig. 20. Steel repair span being rolled out on intact half of masonry arch of Maisons Lafitte bridge preparatory to jacking it sideways and lowering it to position thus returning the bridge to its double-track condition. An old truss, which the Germans had used, lies in the Seine.

to the Ile de Monsin in the Meuse River at Liege, Belgium, and no doubt felt that they had denied us the use of the structure. However, after some further careful demolition of our own and the construction of four steel pile piers alongside the wreckage, a turnout track was built, which permits trains to use the existing three plate girder spans and then bypass the damaged part of the bridge.

The demolitions were necessary to cut the wreckage loose from that part of the structure which it was hoped could be used, and they had to be carefully done for, as shown in Fig. 19, the shoe on the third pier was lifted up in the air as the bridge twisted in falling, and had to be lowered to its bearing as well as pulled shoreward 6½ in. This shoe was first manipulated up and down slightly with 100-ton jacks to see what would happen. When the Engineers of the 332nd G. S. regiment were satisfied that the span was not permanently twisted, the shoe was blocked up, the girders cut at about midspan, and the shoe lowered to bearing by jacks. An intermediate operation after the girder was cut was to pull the intact part of the bridge shoreward with lines from a tractor winch until the shoe was centered over the pier.

A steel H-pile pier was then driven to support the cantilever ends of the original girders, followed by other piers set to accommodate four meter beam spans of 72 ft. each. The turnout was put on an 8-deg. curve which gave ample clearance of the old wreckage.

Installing makeshift trusses

Two bridges on which we furnished the initiative and some of the equipment and materials, but which contractors for the French railways built, illustrate how available trusses, of whatever length or type, can be used to bridge openings in an emergency. Both structures are at the northwest outskirts of Paris on the line to Soissons.

The Maisons Laffitte bridge, a double track structure consisting of ten 105-ft. concrete arches, had one of its spans blown out. More exactly, the half of the arch under one track was out. Across this opening the Germans had erected a steel truss span, which they had lated demolished by dumping in the river. It was too badly damaged to be salvaged so the French made up a new span from three second-hand, double-truss sections as illustrated in Fig. 20.

Erection methods employed

The span was assembled on dollies on the existing track, pushed out opposite the opening and jacked sideways onto cribbing set on bridge seats cast into the piers. The cribbing was removed, as the span was lowered by jacks, and the bridge was double track again. The 341st Engineer General Service Regiment assisted the French on this work.

The second bridge in which a makeshift truss figured was at Chaponval, where the 95th Engineer General Service Regiment cooperated with the French in the repair. Here, three 88-ft. spans were out, one of which was put back by raising one end from the water, while the other two spans had to be replaced. There were no 88-ft. trusses available, but the French were able to locate one of 100 ft. and another of 78 ft. which, coupled together, could span the two openings.

The erection procedure decided upon involved splicing the spans together and launching the whole with the aid of an improvised nose. The splice consisted of a shelf attached to the underside of the shorter truss upon which the longer truss rested. (Fig. 21). As much of a tie as possible was developed between the webs and the top chords of the trusses at this splice by bolted angle connections, but the trusses had not been designed for cantilever erection, and a failure was barely averted. To make up for this basic weakness of the trusses a tower or traveling bent was erected under the splice resting on a track 65 ft. long laid on the top chords of a wrecked span in the water. The illustration, Fig. 21, shows this track being laid preparatory to tower erection. This tower supported the truss splice until it reached its final position just short of the middle pier. There were a good many anxious moments, and the splice had to be reinforced several times when it showed signs of distress, but the spans were finally successfully launched.

Using a German launching derrick

Another railroad bridge in the Paris area (at Neuilly-sur-Marne) whose reconstruction was more truly a job of the French railways than of the American Army Engineers involved the use of a flat-car-mounted beam-launching derrick captured from the Germans. On the same order as the "Long Tom" developed by the 347th Engineer General Service Regiment and referred to earlier,

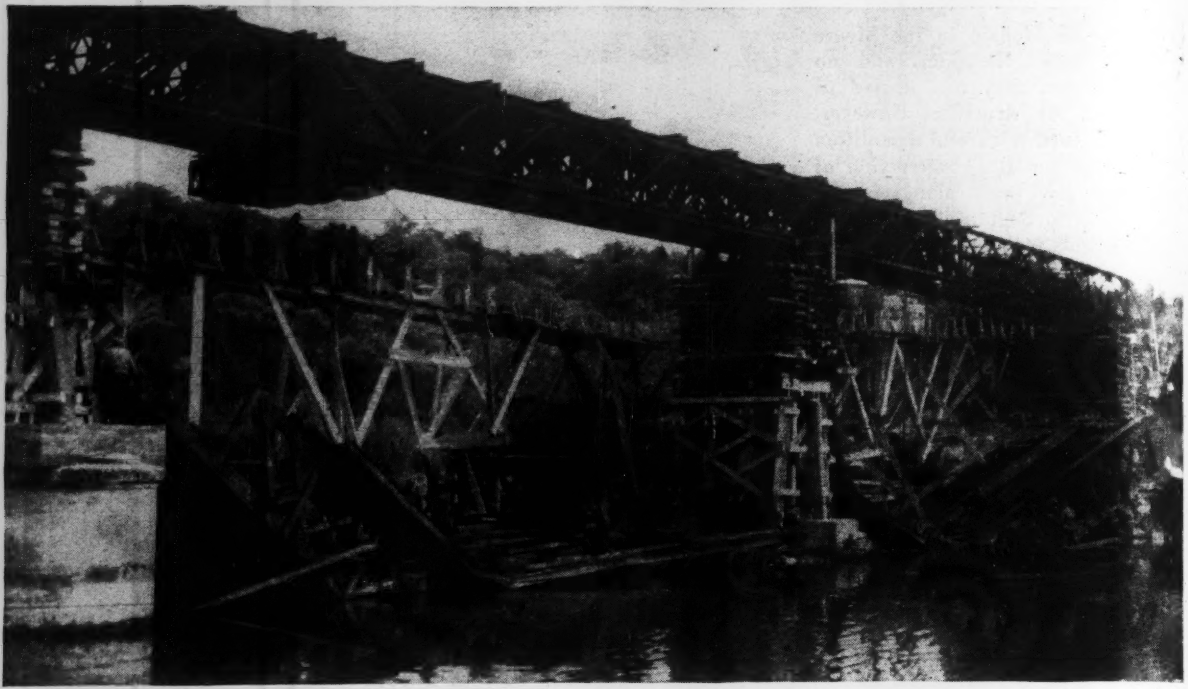


Fig. 21. Second-hand trusses, made continuous by the unusual "shelf" joint near the left end, being launched across two spans of Chaponval bridge over the Seine. Note improvised launching nose at right end. Preparations are underway to erect a movable falsework tower on the wreckage in the river to help support the joint until it reaches its final position just short of the center pier.

the German outfit is a much more finished and elaborate mechanism. Instead of a boom of a single beam, for example, its boom consists of two beams set far enough apart to support the rails of a trolley car that carries the lifting hook (Fig. 22). The ends of the beams are supported by hogback or king post truss framing, the back ends being tied down to the car while the front end extends 45 ft. beyond the car so that a 90-ft. beam or girder can be handled.

The big advantage of this machine over the "Long Tom" is that the beam to be launched can be carried out to the point of use on the flat car instead of hanging from the hook; also more than one beam can be carried. Once at the site, the trolley car can pick up the beam and carry it forward to the end of the boom. Another advantage is that the trolley car can be traversed or moved sideways to deposit the beam in any desired position; the "Long Tom" can only set the beam on the centerline of the track after which it must be jacked over to its final location.

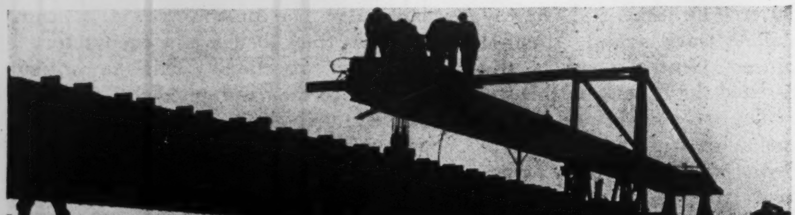


Fig. 22. Captured German launching rig being used to set a 90-ft. plate girder in the Neuilly-sur-Marne bridge.

On the Neuilly-sur-Marne bridge, a high viaduct of 90-ft. meter beam and plate girder spans built to replace a concrete arch bridge, the time required to install each beam or girder was not over 30 min. As a matter of fact, the whole superstructure was completed in 48 hr. after the tall and elaborate timber frame piers were ready.

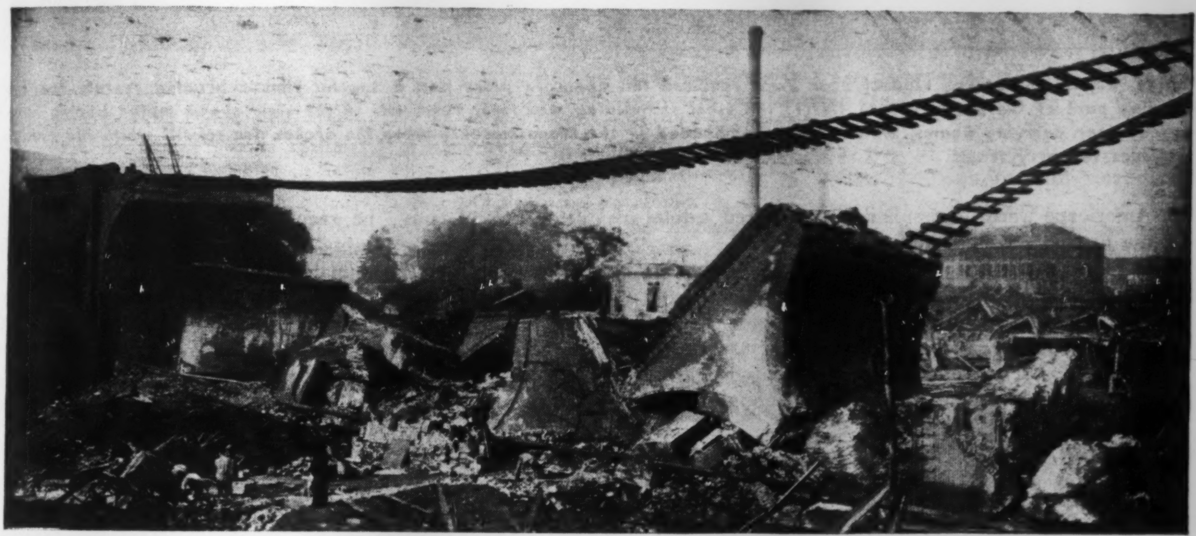
Replacing tall viaduct spans

Various methods have been used to replace tall viaduct spans one of which is illustrated by the structure over a valley at Darnetal near Rouen where about half of the brick arches had been destroyed (Fig. 23). Since the only bridge materials available were some 24-in. beams for the stringers, timber had to be used for the two-bent towers required, giving rise to a considerable timber framing operation since there were 9 towers 40 ft. high, plus extensive raker braces of timber to give stability to the existing stone arches.

Two openings separated by two standing brick arches had to be bridged. One required five and the other six spans of 30- to 35-ft. length. Three of the 24-in. beams were bolted together to form the girder under each rail, and these were set on I-beam grillages atop the 40-ft. high towers, each made of eight squared 12x12-in. timber posts; this was the maximum length of timber available without splicing. Foundations consisted of piers 9x26 ft. in plan dimensions, excavated 10 ft. deep, backfilled with 8 ft. of rubble and topped with a 2-ft. concrete slab. This substantial amount of work was completed in 27 days by colored troops of the 392nd Engineer General Service Regiment, a record the more remarkable for the fact that 10 days were required to clear the site of debris since large blasting charges could not be used because of the proximity of the buildings of the town. Also all of the materials, and even the two crawler cranes with 60-ft. booms used for erection, had to be assembled from all points of the compass after the order to proceed was received.

As the job progressed, the men, with little previous experience in this type of work, became expert timber fabricators. Usual accomplishment was a tower a day. Some of the towers were erected in one piece, but this tended to wrack them, so the practice was abandoned in favor of erecting the two bents of each tower separately and adding the bracing in the air. This was also the method used to install the raker braces inclined against the faces of the existing arches.

A second high viaduct repair job occurred on the Grand Viaduc de Kerhuon east of Brest where four arches and two piers at the west end had to be replaced. The original structure consisted of eleven 46-ft. span stone arches 105 ft. high to the springing line, and was thus of major proportions. Obviously too high for a timber substructure, it was decided to build two new concrete piers on the old foundations, and the 373rd Engineer General Service Regiment started these and had them up about 40 ft. by the time Brest surrendered.



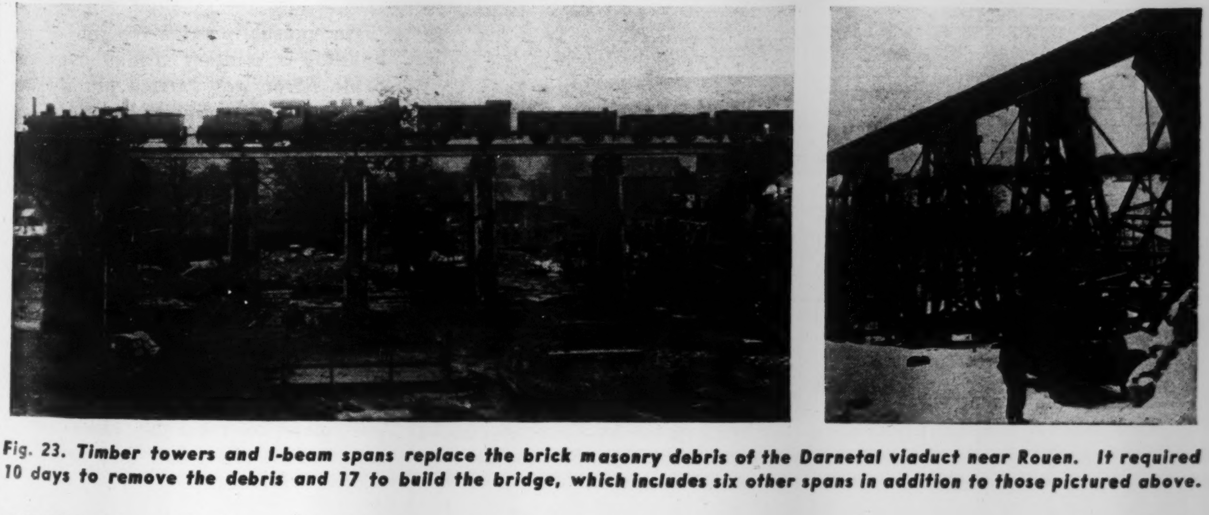


Fig. 23. Timber towers and I-beam spans replace the brick masonry debris of the Darnetal viaduct near Rouen. It required 10 days to remove the debris and 17 to build the bridge, which includes six other spans in addition to those pictured above.

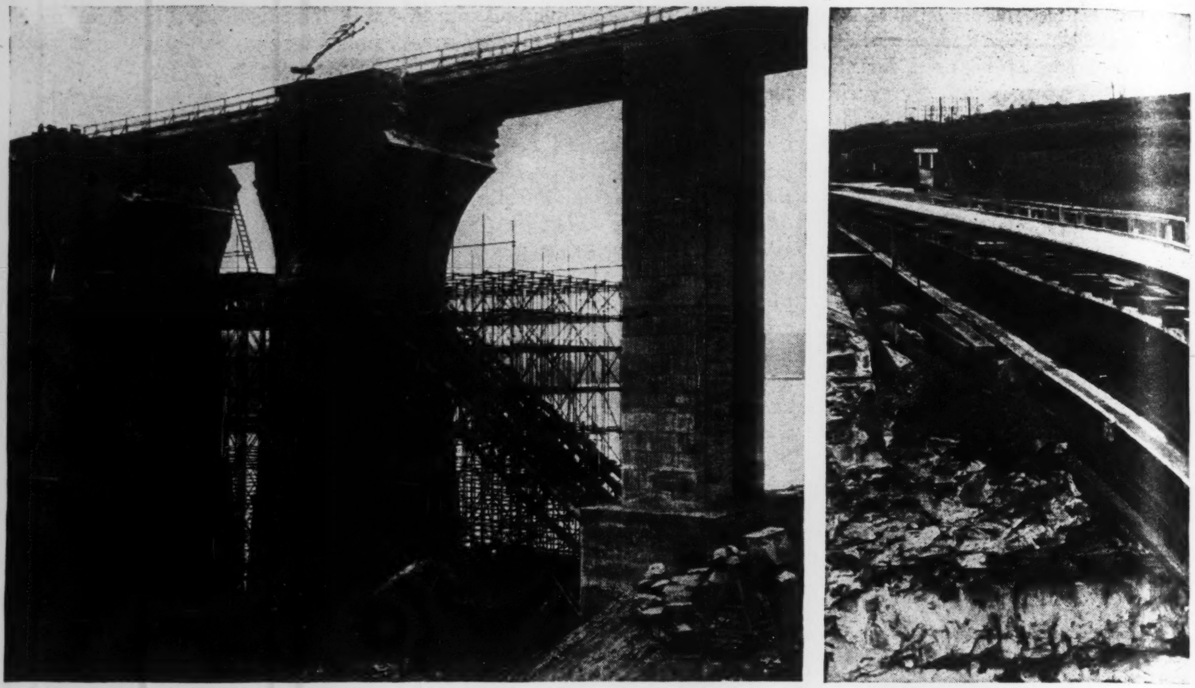


Fig. 24. Repair of Kerhuon viaduct near Brest required tall concrete piers and a special timber bracing system for the standing part of the old structure (left); the steel scaffolding was later removed. Right view shows meter beams resting on other carrying beams, which will be embedded in the stone masonry when the arches are rebuilt while the bridge continues to carry traffic.

The Americans were then pulled out, and the French finished the job.

The piers (after the French took over) were poured from a temporary construction bridge built out from the abutment on steel rod scaffolding, such as is shown in one of the accompanying illustrations. They required a total of 740 cu. yd. of concrete.

Perhaps the most interesting detail of the job is the fact that the two meter beams under each rail are themselves set on 20-in. deep longitudinal girders in order to raise them enough that the masonry arches can be reconstructed beneath them; the supporting girders will, of course, be imbedded in the new construction. Another special feature of the job is the method used to counter the thrust of the standing part of the structure; a horizontal timber joist carries it to the free-standing masonry pier, and then an inclined strut on the other side of this transfers it into the ground at the new concrete pier footing.

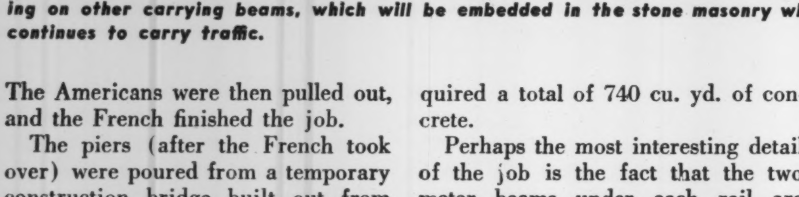


Fig. 25. Converting a UCRB span of the bridge at Le Manoir over the Seine above Rouen into a lift span by utilizing the standard erection gantries as the hoist towers. Wreckage of the original bridge is in the background.

Raising UCRB spans

An unusually extensive job of rebuilding a military bridge over the Seine River was carried out by the British Royal Engineers at Le Manoir just upstream from Rouen in which the entire structure of six 75-ft. UCRB deck spans and two 40-ft. beam spans on LST trestling was raised 4 ft. to give more floodway. In addition, one of the deck type UCRB's was first converted to a through type and then to a lift span. Finally, two of the 75-ft. UCRB's were converted into a three span (55-55-40 ft.) continuous unit by the construction of two new pile piers to take the place of a camel's-foot piers that had been installed originally.

The necessity for this large amount of work arose from the fact that the bridge had been built in a great hurry to meet military operational requirements, had nearly been lost in the November floods, and was a key structure in the British supply lines just as the Juvissy bridge had been in ours. The floods had washed over the deck, and the bridge had only been saved by loading it down with cars of coal. Also one of the camel's-foot piers settled as the bottom around it slid into a bomb crater. In spite of this the bridge was kept in service, although at one time the track dipped 2 ft. over the bad pier.

The first operation was to raise the entire bridge 4 ft. by hydraulic jacks and install cribbing on top of the LST piers. Next, the center span was raised an additional 4.2 ft., also by jacking, being converted to a through-type span in the process. This gave 8.2 ft. clearance under this channel span, and then an additional 10 ft. was obtained by installing gantry frames of LST members over the piers and making a lift span out of it. Chain hoists were used initially, later to be replaced by electric hoists for operating the span.

The new pier construction required for converting the existing simple spans to a continuous unit was more exacting than the raising operation because pile driving had to be carried on in constricted quarters. Those piles on the alignment of the structure were driven through the deck by a hammer on the hanging leads of a locomotive crane, while the others were put down by a hammer in skid-type leads mounted on a barge of Seabee pontoons. Square timber piles equipped with a steel driving shoe and a circular steel driving head were used, as is common British practice. Such piles are claimed to involve less wastage than rough pole piles since the cutoff parts can be used for blocking, and in addition bracing can be framed into square piles more easily than into round ones.

The Le Manoir bridge is now a substantial structure at a high enough level to clear all floods, and with a lift span that can pass any river vessel. It is one of the outstanding examples of the use of the British military bridging materials in the European Theater.

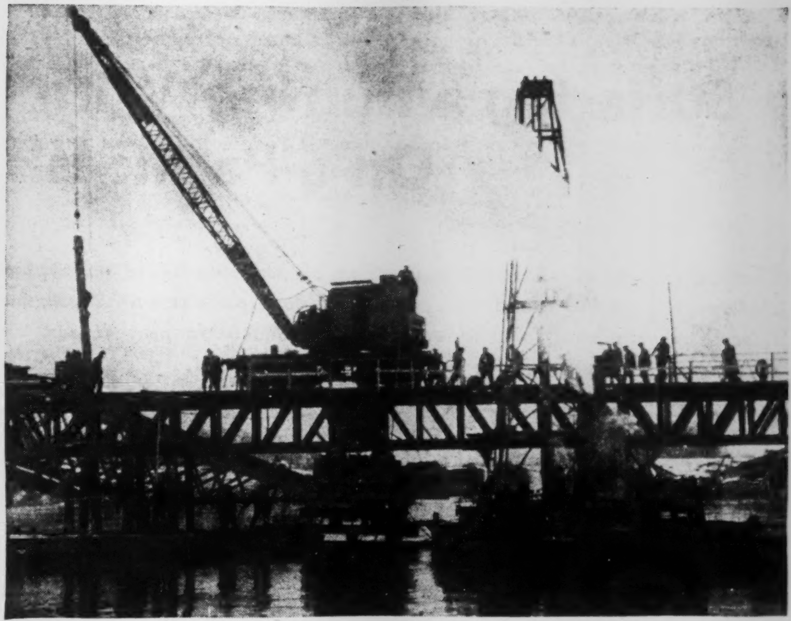


Fig. 26. When the pier supporting two simple spans of the bridge at Le Manoir settled badly they were changed into a three-span continuous unit by the construction of two new piers. Locomotive crane drives piles for one pier, while a driver on a pontoon float works on the other one.

Overseas Equipment Salvaged at Rapid Rate

The Corps of Engineers is prepared to take care of the repair of battleworn equipment returned from Europe at the rate of 5,000 pieces per month, in addition to the normal maintenance of equipment in this country, Col. E. R. Needles, chief of the redistribution and salvage division, Office of Chief of Engineers, reveals. During 1943-1944 approximately 85,000 pieces of equipment went through the shops, while 55,000 are expected in 1945. The rebuilding program has varied from 2,000 pieces undergoing major repairs at one time, to as high as 8,000 pieces. On April 15, 1945, 2,120 pieces were listed as under repair, with 819 being shipped into depots and 685 shipped out during the month. The average value of the units was $2,000.

The repair work of the Corps of Engineers varies from the delicate adjustment of surveying equipment at the engineer section of the ASF Depot at Columbus, Ohio, to the overhauling of large cranes and tractors at numerous shops over the country.

In addition to material received from overseas, all equipment used in the United States is sent to the shops for reconditioning after each major job. No heavy equipment is redistributed or reissued after use without receiving a thorough overhauling.

Both the commercial and government shops are using many newly developed devices to speed repairs. Among them are a treadmill-testing unit; a special track pin press, which punches out bushings; and a metallizing process which preserves critical materials by spraying worn parts with molten metal to build them up to oversize, thus permitting them to be cut to the proper dimensions.

While great quantities of equipment are being restored to use through the repair program, Colonel Needles stated that, nevertheless, it remains the policy of the Corps of Engineers to send only new equipment, or equipment in excellent condition, to Engineer combat areas.

Surfacing a Runway With Volcanic Sand On a Pacific Island

***Contents in Brief**—Speedy construction of an extension to an airplane runway on a Pacific island was preliminary to experiments with combinations of Marston mat, oil and water in an endeavor to prevent dust and raveling on a paved surface made with volcanic sand.*

"JUNGLE to landing strip in 10 days" is no exaggeration in the case of a job done by Seabees on a Pacific island when pressure from the nearby Nips made it necessary to speedily extend an existing runway. The clearing and grading job involved unusual features even for tropical jungles and deserves to be mentioned briefly. Of even more interest, however, are the experiments and the strenuous endeavor directed toward finding some practical way to prevent dusting and to make a satisfactory airport surfacing with the volcanic sand which had to be used in the absence of any other material.

A 2,000-ft. runway in 10 days

Orders for the addition, in the absolute minimum of time, of another 1,000 ft. to the length of the airstrip found a well equipped group of Seabees ready for just such an emergency. They finished the job in 10 days, completing not a 1,000-ft. extension but an additional length of 2,000 ft. They had found that by making the borrow pit on the line of the strip beyond the designated end, the removal of the needed material would leave the borrow area available for doubling the specified length. This discovery by the construction crews implies no reflection on the original survey, the officer in charge pointed out, because the jungle on this volcanic island is so thick that the only way to get a survey through is to drive a bulldozer into it, using a compass for recording the route traveled. When the grading job was done measurements showed that some 80,000 cu.yd. had been moved in 10 days and that at times as much as 9,600 cu.yd. was handled in 12 hr.

The Seabees moved in with eleven carrying scrapers (6- to 8-cu.yd. capacity) and twelve to fourteen 2½-cu.yd. dump trucks, served by 1½- and 2¾-cu.yd. shovels. The normal working program was three 6-hr. shifts. This made possible special attention to maintaining equipment. All the available equipment was used; there were no spares that could be laid up for repairs. Every precaution was taken, therefore, to keep every unit working. Greasing was done twice a day. If any unit developed a weakness or a part became loose the machine was taken immediately to the shop and was given the necessary attention at once even if the result slowed up the work. The repair shop was expected to do "almost anything" and make the finished job amply strong. For example, when a channel iron in a chassis frame was welded, strengthening plates were put on inside and out. When a 1½-in. dia. shaft in a diesel motor was broken it was welded together by turning each of the broken ends to a cone, setting the two pieces in a lathe and making welds on a 90-deg. spacing to avoid shrinkage.

Standard equipment for a single battalion would have been insufficient for this job. Successful handling of the work is cited as an example of the advantage in the regimental control system used in the Seabees which is far different from merely superimposing a regimental staff on the regular battalion organization. The Seabee plan puts the facilities of the entire regiment under a single head. On this job a regimental command could muster and assign equipment held by any part of the regiment—nothing could be diverted to relatively unimportant work or to just keeping a detachment busy. There was only one master priority list and this made possible the assembly of equipment that was used so effectively to finish the work in record time.

Volcanic activity on this island in some prehistoric age had covered the entire area with a blanketing layer of very light material, almost black in color, gritty and impregnated with ashes, commonly called volcanic sand. It drains with unbelievable speed. For example, if clammed up out of a swamp and piled along a proposed roadway route, it will drain off and be immediately serviceable as a roadway as soon as the fill is brought above water level.

If adequate drainage ditches are provided the tropical downpour on a well-rolled road will do little harm because the rate of percolation is so rapid. Very soon after a heavy rain the surface will be entirely dry and dusting begins almost at once. It works well when wet. In fact, to blade a roadway when it is dry is to damage the surface and to leave it dusty to the choking point.

The instability qualities are a disadvantage. With any velocity of stream flow it becomes a very unsatisfactory material because it will erode on even vary flat slopes. Drainage ditches continually tend to fill and require constant attention because of deposition.

The runway surface problem

As the result of experience with volcanic sand in road construction, when the first runway was surfaced Marston mat was laid in an endeavor to prevent excessive dusting and raveling. This was not a satisfactory solution because the operation of planes at all times, other than during actual rainstorms, brought dust up through the holes in the steel.

In surfacing the extension, therefore, although the Marston mat was used in lieu of any better plan, endeavor was made to decrease the excessive dusting that had occurred on the original job. A 2-in. layer of sand was put on top of the mat and instead of working it down through the holes with hand brooms, as had been done before, a road grader with blade reversed was run over the mat to insure a uniform depth of distribution of the overlying material. Then this layer of volcanic sand was washed down through the holes in the mat and into the subgrade with an extremely heavy flushing. This work, amounting to a flooding, was done with sprinklers working on a 24-hr. schedule until they had been over the entire area twice. This gave the subgrade a much better "fit" under the mat than before.

Emulsified asphalt used

Even though this decreased the tendency of the steel plates to rattle and "pump," there was still enough movement to draw dust from under the steel itself as well as up through the holes. In dry weather the dust on the airstrip extension was so bad that some further treatment was required.

This time it was decided to try emulsified asphalt. There was available a stock of 500 bbl. of asphalt emulsion consisting of 40 percent water. Before application this emulsion was further diluted by the addition of five parts of water to one of emulsion. It was believed that repeated applications of this dilute mix would be better than a more concentrated treatment. In preparation for the oil the mat was swept by hand, to remove the dust, after which the emulsion was applied as soon as possible. The sweeping was done between 8 p.m. and 2 a.m. and daily applications of emulsion was made early in the morning before the rain that usually came each day.

Treatments were only palliative

Experiments carried out in connection with this work varied the dilution, the number of applications and any other elements in the treatment that gave any hope of better results. On small test sections as much as 4 gal. per sq.yd. was put on to experiment with excessively heavy dosage.

In the end it appeared that at best these treatments were only palliative. Where the oil was sufficient in quantity to make a crust, little circular cakes formed in the holes and the vibration of passing planes, followed by the slip stream from the propeller, often removed these cakes bodily from the holes exposing the untreated material beneath as a fresh source of dust.

From one viewpoint, the attempt to use asphalt emulsion seemed futile and there was advantage in not trying to seal the surface but to let the water go down through it, controlling the water table by ditches on the side and supplementing the frequent rains by a nearly continuous sprinkling program. In volcanic sand there is such a thing as lowering the water table beyond the advantageous level.

One objection to a heavy sprinkling program was that sprinkler trucks working on the runway constituted a menace. Despite sirens to warn them off when planes were to land or take off, considerable risk was involved both to the planes and to sprinkler outfits. A substitute plan that met with favor was the laying of water pipe on either side of the strip with taps at convenient intervals for 300-ft. hoses to be operated by workmen on foot. The men could get out of the way quicker than was feasible with the more cumbersome motor trucks.

Personnel participating in the speedy construction of the airstrip extension included the following: C. T. Wende, Seattle, Wash., officer in charge; Lieut. J. Y. Barnes, Clear Lake, Iowa, in charge of grading. Other officers in positions of importance were Lieut. S. E. Hoffman, St. Louis, Mo., and Ensigns M. Davanish, Detroit, Mich., and E. A. Danville, Mt. Vernon, Ohio.

Chlorine Contact Period in Outfalls Determined with the Aid of Dye

A simple dye test for determining the period of chlorine contact afforded by sewage plant outfalls is employed by the Interstate (New York, New Jersey and Connecticut) Sanitation Commission in making field investigations. The procedure followed is to place a small quantity of a fluorescein dye at the point of chlorine application and note the time required for the color to appear in the receiving waters in the vicinity of the outfall pipe.

The dye used is uranine yellow, the same material employed by the Army and Navy in outfitting life-rafts used by fliers when they are forced down at sea. When the dye is added to water it disperses in a large circle that persits for a considerable period of time and is clearly visible on the water's surface.

Reason for tests

At some sewage disposal plants, states Seth G. Hess, director and chief engineer of the commission, in a recent report, the outfall pipe is of considerable length and it is desirable to know how long the sewage remains in contact with the chlorine.

"The importance of the contact time," continues Mr. Hess, "is that the effect of the chlorine on all of the bacteria is not instantaneous and it has been determined that its effect is cumulative up to approximately 20 minutes. Since it is not practical to obtain a sample of the sewage from the end of the outfall pipe which is underwater, it has been the commission's practice to take the sewage samples from the last available point on shore, and to hold that sample for the necessary time as determined by these tests, before using the sample for inoculating the lactose broth media."

"By this procedure we approximate the conditions which exist at the end of the outfall" concluded Mr. Hess, "and determine in the best possible manner the number of coliform organisms present in the sewage as it is discharged into the waters."

Special dye available

Uranine yellow, the fluorescein dye that has been found by the commission to be the best for these tests, is said to be obtainable from most chemical supply houses.

The dosage of the dye is based on volume of flow and anticipated detention time. When the detention period is less than 30 minutes, one ounce of dye is added to sewage flows not exceeding one million gallons; for flows of one to 4 m.g. the dye dosage is 2 oz. If the detention period is greater than 30 minutes, the above dosages are doubled.

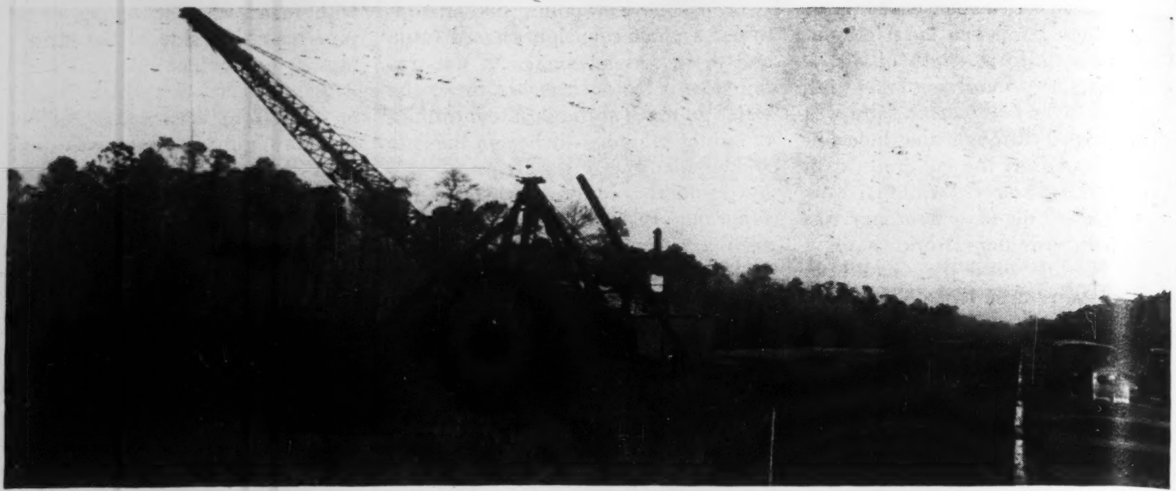


Fig. 1. A clam-shell dredge takes out top cut to make a channel for a hydraulic dredge that deepens the cut to solid ground.

Dredges Build a Swamp Road

***Contents in Brief** — After several unsatisfactory attempts to construct a highway across a swamp where an average of 30 ft. of root growth and muck covers the first layer of stable material, engineers of the North Carolina State Highway Department have developed a satisfactory construction procedure. It consists of removing the root mat and enough of the unstable soil with a clamshell dredge to obtain flotation for a suction dredge, which excavates the remaining muck. A second suction dredge pumping sand from borrowpits makes the backfill soon after excavation is completed. The fill will be surfaced with a flexible pavement, which will adjust itself to small settlement and is easily restored to true profile.*

AN EXCEPTIONAL APPLICATION of hydraulic dredging in constructing highway grade is solving a difficult problem of roadbuilding in northeastern North Carolina. The new work is planned to end a twenty years' struggle by the state highway department to provide a stable road over a tidal marsh, which is just east of Elizabeth City.

In the new work, a clamshell dredge followed by a hydraulic dredge excavates a trench from 10 to 30 ft. deep and from 50 to 70 ft. wide through the swamp muck to solid ground, and a second hydraulic dredge pumping from distances up to a mile fills the trench with sand close behind the excavation. The sand fill, built up to 5 ft. above swamp level, will be finally surfaced with an asphalt pavement that will adjust itself to minor grade subsidences and can readily be built up to restore true grade.

The importance of the road has led to a checkered history of the swamp section being rebuilt. The road is a main state and United States trunk line from Elizabeth City to the city and port of Norfolk, Va. It is the only main highway of access and egress for three northeastern counties set apart by the Pasquotank River and Albemarle Sound. The road was taken into the state system in 1921; it was previously a toll road.

Design of original road

As then taken over, the swamp section being considered was corduroy resting on the marsh root mat and covered with earth. It had a 16-ft. roadway which was impassible most of the time and could bear only light traffic at any time. Reconstruction was undertaken in 1922. It consisted of a bedding layer of earth on the old roadbed, on this another corduroy course, a layer of earth and finally a 16-ft. reinforced concrete pavement. It was expected that the new structure would float and hold its grade on the swamp top, but it did not. By the time reconstruction was finished most of the surface was an inch or so under water due to settlement. Settlement progressed until by 1924 any considerable wind tide made the road impassable except for perhaps a quarter of a mile at the east end and this was covered with water much of the time.

Second trial a failure

A reconstruction program was started in 1924. The first plan was to build up the lowest sections with a slag fill over the concrete slab. To hold the slag in place curbs or bulkheads were built by nailing planks to piles driven along both edges of the old concrete pavement. About half a mile of this construction was completed when settlement indicated that it would provide only temporary relief and the work was stopped. Incidentally, in driving the rows of piles it was had in mind that ultimately they could be used to carry a concrete slab.

Instead of a concrete slab, a low-level timber causeway was built. The

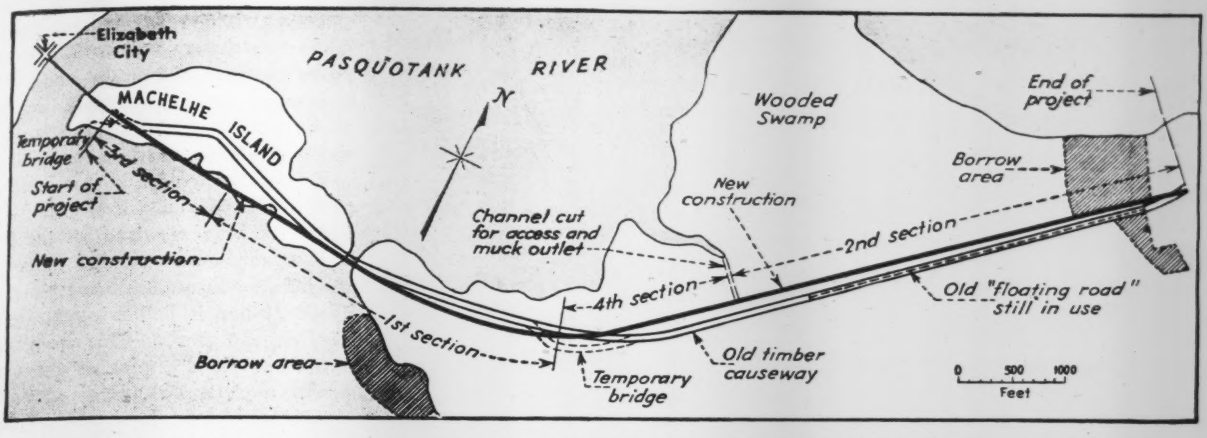

Elizabeth City
PASQUOTANK RIVER
MACHELHE ISLAND
Temporary bridge
3rd section
Start of project
New construction
N
Channel cut for access and muck outlet
Wooded Swamp
New construction
2nd section
Borrow area
End of project
4th section
1st section
Borrow area
Temporary bridge
Old timber causeway
Old "floating road" still in use
0 500 1000
Feet

Fig. 2. New location smooths out alinement and maintains the old road in service during the work of replacement.

piles were capped with 16 x 14 in. timbers lying across the old road and carrying a plank roadway 17 ft. wide. Construction was begun in 1926 and carried on intermittently until 1931 when about two miles of causeway had been completed as indicated by Fig. 2. Designed for a 15-ton truck, the timber structure gave excellent service for a number of years but with increasingly heavier and faster traffic upkeep became costly. Consequently, an entirely new road was decided on.

Previous construction experience showed the need of careful site and ground condition studies for the new road. The location, as shown by Fig. 2, is east from the Pasquotank River bridge at Elizabeth City, the full length of Machelhe Island, to and across a tidal swamp peninsula for 2½ miles. The natural ground surface is only a foot or so above mean water level and is frequently flooded. Soundings along the route indicated a typical soil profile of 4 to 8 ft. of root mat over 15 to 30 ft. of swamp muck on 1 to 10 ft. of blue clay overlying a firm sand.

With these soil conditions, any certainty of securing a permanent road grade involved removal of the swamp muck to the solid clay and then replacing it with stable borrow material. The line was located with regard to reducing cut and fill, but does not depart far from the old road except for a short distance on Machelhe Island. Surveys disclosed sand for fill at two places within economical pumping distances.

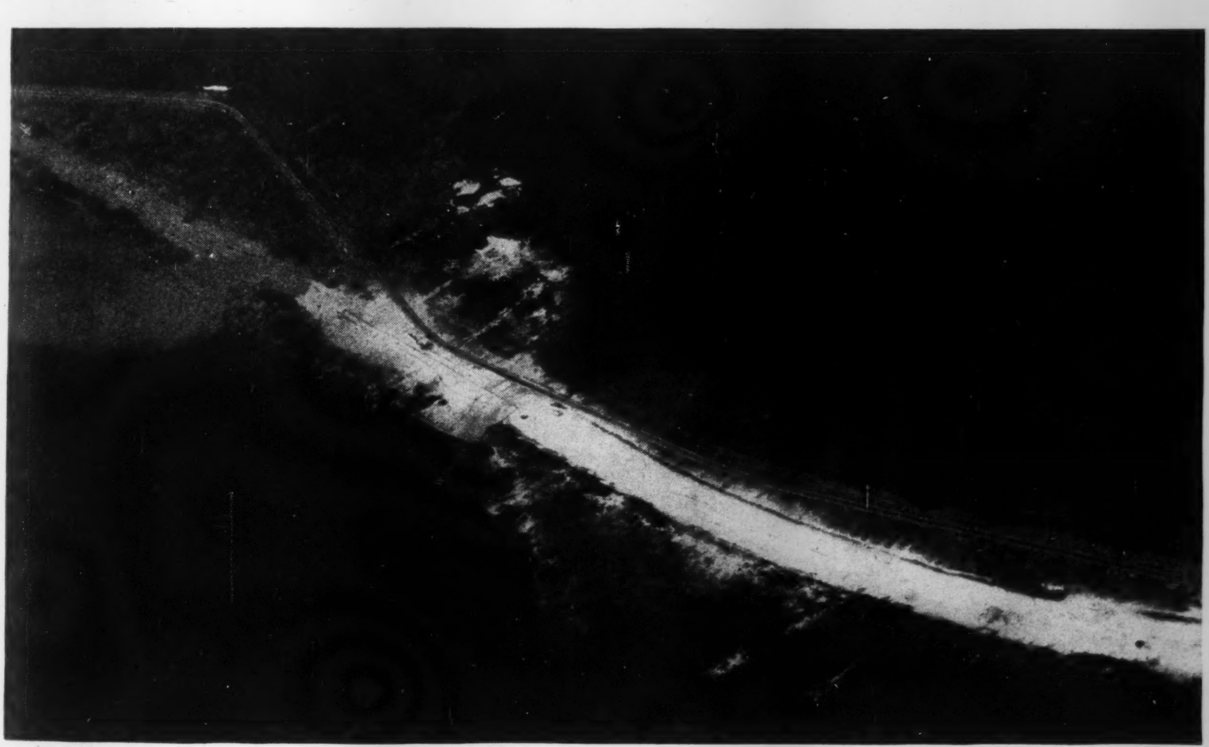


Fig. 3. Sand-filled dredge cut across tidal marsh replaces timber causeway, the last of several unsuccessful attempts to span permanently a deep muck bed east of Elizabeth City, N. C.

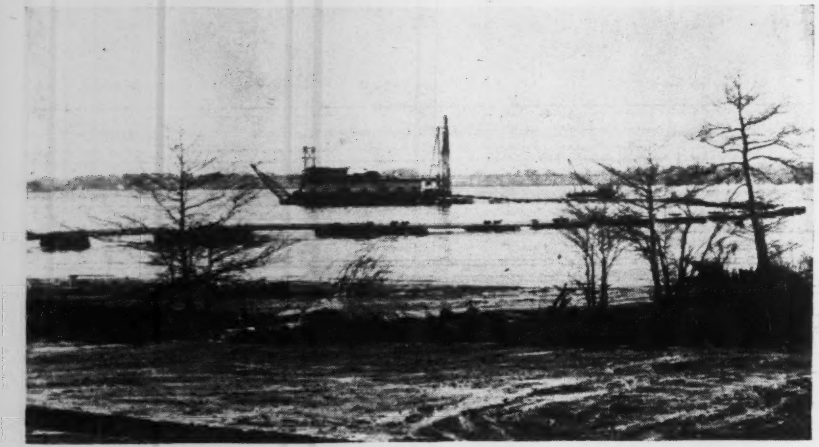


Fig. 4. A hydraulic dredge pumps sand into dredged cut to make the solid fill that is to carry the new road. The dredge, operating round the clock, is able to pump 5,000 cu.yd. daily through a mile of pipeline.

The road structure decided on was a sand fill 40 ft. wide on top, with a 22-ft. flexible asphalt pavement and two 5-ft. shoulders, placed in a trench excavated through the swamp soil to solid sand. The designed widths of trench were: 50 ft. for cuts up to 15 ft. deep; 60 ft. for cuts 16 to 25 ft. deep, and 70 ft. for cuts 25 ft. or more in depth. Pay excavation was limited to the trench dimensions specified.

Dredged cut and fill

With requirements as described, dredge construction was the obvious plan. Because it was readily available, the contractor is using a floating rig (Fig. 1) equipped with a 100-ft. boom and handling a 2½-cu.yd. clamshell bucket to do the preliminary excavation. This unit, which is a rebuilt dipper dredge powered by 100-hp. diesel-electric engine, removes about the top 10 ft. of the material to be excavated. A 16-in. suction dredge equipped with a 300-hp. diesel engine as the main power unit follows the clamshell machine and completes the excavation.

Early in the work this dredge frequently completed the excavation for a given section some days before the sand backfill was added. However, on one portion of the project where the excavation was some distance ahead of the backfilling, an extremely severe wind condition resulted in the tide falling 6 ft. in 3½ hr., which resulted in an equal drop of the water in the excavated trench. The result was such extensive sluffing along the edges of the trench that 60,000 to 70,000 cu. yd. of extra excavation was necessary. This experience resulted in a decision to completing the excavation only a short distance ahead of backfilling.

Before the project is completed, a total of 600,000 cu. yd. of excavation will have been required for the job.

A 16-in. suction dredge (Fig. 4), discharging through a line frequently a mile long, is delivering the sand used as fill material. This dredge has a 600-hp. diesel engine as the main power unit; a 150-hp. diesel motor driving the cutter head, and another 150-hp. motor driving the pumps and other auxiliary equipment. Operated by a 7-man crew, the dredge is kept in service 24 hr. per day seven days a week. With such a schedule as much as 185,000 cu. yd. of material has been placed in one month.

The part of the delivery pipeline extending over the water consists of 40-ft. sections each supported on two pontoons 4 ft. in diameter and 12 ft. long, the sections being joined with flexible rubber sleeves. On land, a lightweight pipe with bell and spigot joints is used. The 16-ft. sections of this pipe can be moved forward by hand as the work progresses, the two sections of pipe at a given joint being held in place by two heavy ties of twisted wire.

Control of fill

To spread the discharge over a large area and thus retain the maximum amount of the transported load

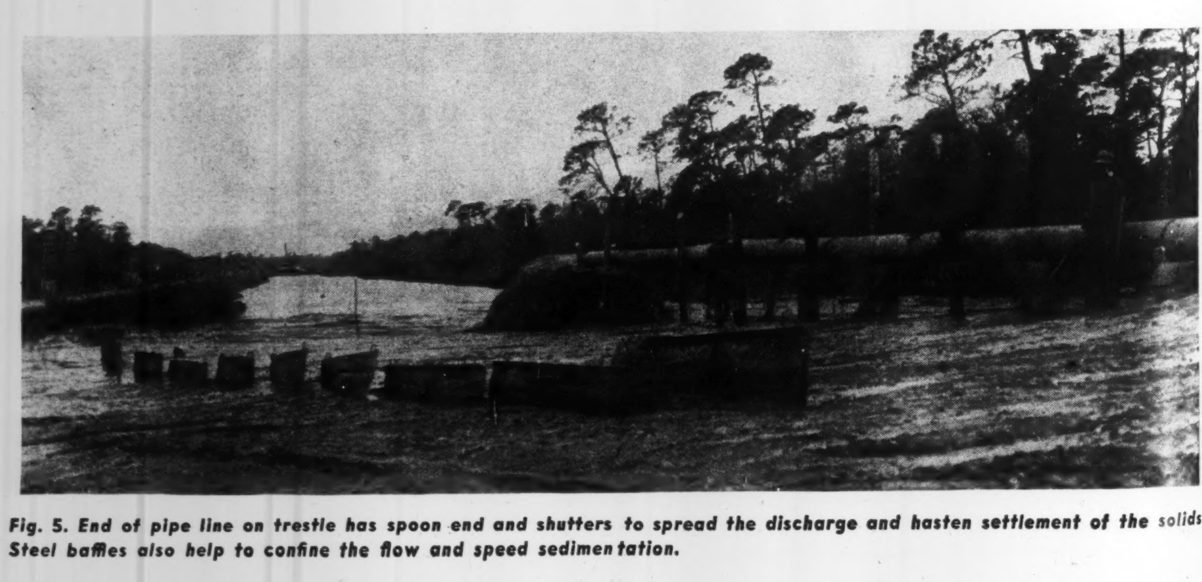


Fig. 5. End of pipe line on trestle has spoon end and shutters to spread the discharge and hasten settlement of the solids. Steel baffles also help to confine the flow and speed sedimentation.

on the fill, the discharge end of the pipeline is equipped with a special "spoon". Also, several sections near the end are supported a few feet above the previously placed fill and are equipped with bleed holes, placed on the lower side, from which material is obtained to build up the top section of the fill. As a further aid to keep the delivered water on the fill long enough to permit the suspended load to be deposited, sheet metal forms or panels about 2 ft. high and 10 ft. long are used. Easily handled by two workmen, a number of these are forced into the previously placed material, end to end, to form a nearly continuous barrier.

Despite these several precautions, the contractor will probably need to deliver 25 percent more sand than the theoretical total of 900,000 cu. yd.

Constructed in four sections

To keep pipeline lengths to a minimum and to cause the minimum inconvenience to traffic using the present road, the construction is being carried out in four sections. A temporary timber bridge has been constructed over the east end of the first fill section and a similar bridge crossing at the west end of the project where it ties in with the existing drawbridge.

Traffic will not be placed on these temporary bridges, however, until it is necessary to remove the old causeway at these points to make way for the new construction. At the east end of the project where the new fill is immediately adjacent to the old road, the existing pavement has been kept in service by use of a bulkhead alongside the old road and by special care in depositing the sand backfill.

Since it is not practicable to extend the fill all the way to the end of the bridge over the river, this connection will be made by constructing a concrete causeway 210 ft. long. Bids on this work under a separate contract were received recently, and the structure is expected to be completed at about the same time as the grading work.

Who is doing the work

Good progress is being made and the grading of the road is expected to be completed on schedule about Sept. 1. The work is being done without federal aid by the North Carolina State Highway and Public Works Commission, for which W. V. Baise is chief engineer, and J. C. Gardner, division engineer. W. S. Winslow, hydrographic engineer, made the general layout for the project and is giving general supervision to the construction. W. J. Overman is resident engineer on the project.

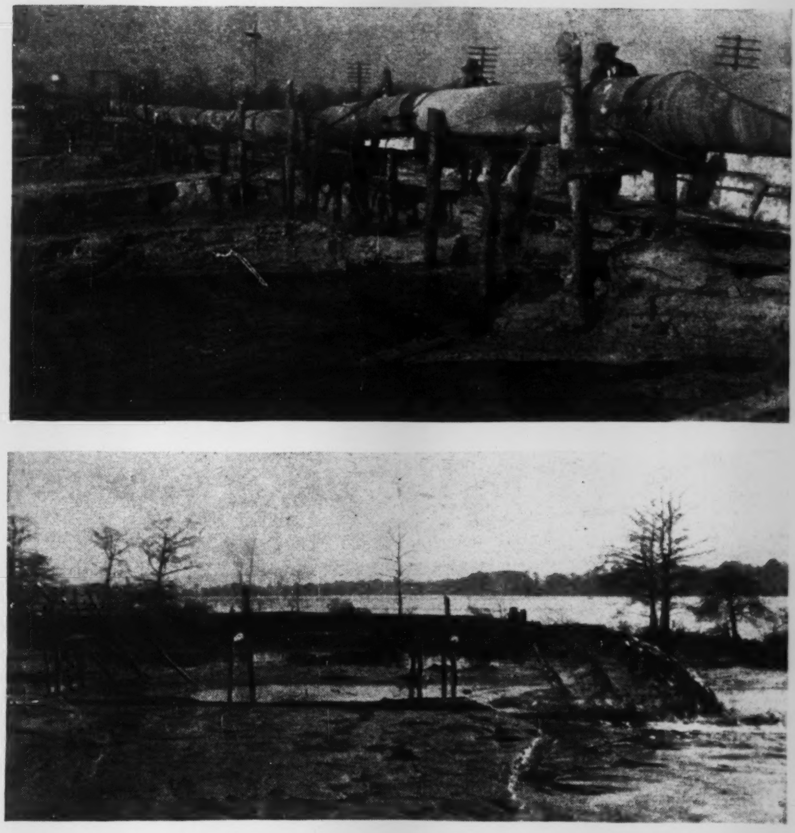


Fig. 6. Part of the dredged material is delivered to the fill through bleed holes in the bottom of the discharge line from the dredges (upper picture). At its outer end, the line is equipped with a spoon to spread the flow over a wide area.

The contract for the grading work, which is expected to cost about $330,000, is held by the R. C. Huffman Construction Corp., Norfolk, Va. with W. J. Raye acting as general superintendent. The flexible pavement will be constructed at a later date under an additional contract.

Sludge Gas Used for Power and Heating

Indicative of the economies that can be effected by using sludge gas as a source of power in sewage treatment works is the experience of the Gary, Indiana, Sanitary District during four years of operation as shown in its annual report for 1944. For the four years, 1941 to 1944 inclusive, the total value of sludge gas utilized for power and heating was $87,021, or an average of $21,754 per year, equivalent to 1½ c. on the Gary tax rate.

The quantity of sludge gas produced during 1944 was the second highest total in the four years, and with drought conditions making sewage flow more uniform during the last seven months of the year it was possible to use a minimum of standby electric power. Value of the gas used for power and heating was $22,661, the highest yearly total to date, while the $11,757 electric power bill for the same period was the lowest for any year to date.

In terms of dollars, says the report, the sludge gas use satisfies approximately two thirds of the value of total power requirements, while in terms of average load it represents approximately 80 percent.

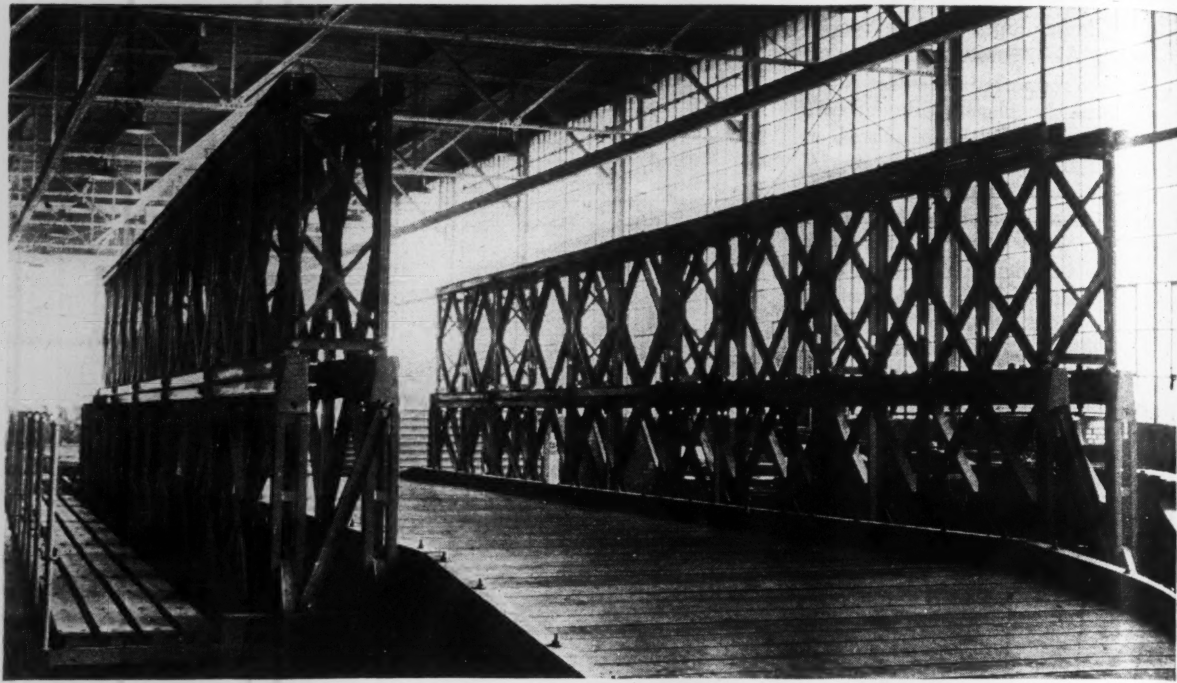


Fig. 1. A few panels of a Bailey bridge were assembled to test the precision of the workmanship.

Fabricating the Bailey Military Bridge

***Contents in Brief**—Fabrication of the Bailey bridge required precision workmanship to expedite its erection and to insure any member fitting accurately into any other such structure whether it was of British or American manufacture. Assembly line methods permitted rapid production; accurately fabricated floorbeams, stringers and timber floorings insured fast erection.*

SO MUCH HAS BEEN WRITTEN of the important role played by the versatile Bailey bridge in crossing the rivers, of Europe and many other streams on other battlefronts, that any additional description of its usage seems unnecessary. But a behind-the-scenes view of the precise methods required in its fabrication should give some insight into why Bailey bridges could be erected so quickly even under the most adverse conditions. Accordingly, this is a story of its fabrication.

Just a word about its erection in order to understand better the requirements of its fabrication. Any reasonably desired length of bridge could be obtained by pinning together successive sections of standard 10-ft. long all-welded truss panels and adding steel floorbeams, stringers and timber flooring (*ENR* Aug. 10, 1944, vol. p. 158). Trusses were erected in several combinations using a maximum of three each side of the roadway and three tiers high.

Interior trusses were erected 12 ft. 11 in. apart, providing a 10-ft. 9-in. clear roadway. In a double truss the second truss was placed 18 in. outside of the interior one, and in a three-truss combination the outside truss was spaced $8\frac{1}{2}$ in. from the center truss. In tier construction the upper truss was placed directly on the one below and bolted to it with two $1\frac{3}{4}$-in. bolts per panel to resist horizontal shear between tiers. Provisions also were made for erecting a $2\frac{1}{2}$-ft. cantilevered sidewalk on either side of the bridge.

Five companies fabricated the Bailey bridge in the United States: the Ceco Steel Products Corp., Chicago, whose practices are the subject of this article; Commercial Shearing and Stamping Co., Youngstown, Ohio; Detroit Steel Products Co., Detroit, Mich.; International Steel Co., Evansville, Ind.; and the Virginia Bridge Co., Roanoke, Va.

Precision fabrication required

Precision was required for all main members. It was mandatory that each be fabricated so it not only would fit others manufactured in the same shop but also fit perfectly into any Bailey bridge regardless of whether the connecting member was of British or American manufacture.

Truss panels were fabricated in special jigs to insure accurate workmanship. Each panel contained eight precision-drilled holes: four horizontal to receive $1\frac{3}{4}$-in. dia. panel. or end pins for connecting with the adjacent panel and four vertical, which took $1\frac{3}{4}$-in. dia. chord-block bolts to resist horizontal shear between trusses when erected in tiers. These eight holes were drilled to a tolerance of plus or minus 0.005 in., while their horizontal and vertical spacing was not permitted to vary more than $\frac{1}{32}$ in. either way.

Each top and bottom chord of the 4-ft. 9-in. deep, 10-ft. long truss panels contained 17 pieces, welded in correct position with $\frac{3}{16}$ or $\frac{1}{4}$-in. fillet welds. Main members were two 4-in. deep channels set 3 in. back to back, with their flanges turned out. Chords had male and female ends. A 3-in. thick, 4-in. deep pin plate was welded between the channels to form the male end, while the female end had a $1\frac{1}{4}$-in. pin plate welded on the inside of each channel web. Two 3x3x$1\frac{1}{4}$-in. plates were welded between the channels at the chord-block bolt locations.

Web members of a 10-ft. panel included two end posts, a vertical post extending the full length of panel at its midpoint, and eight short pieces of diagonals arranged to form two full diagonals and four half-diagonals. All web members were 3-in. channels. Twelve male and twelve female end posts were furnished with each bridge. They were pinned to the top and bottom chords and those in the lower trusses were drilled to bear on a $2\frac{1}{2}$-in. dia. pin in an all-welded pedestal, which slid on bearing plates for short spans and rested on rollers for long spans.

Truss chords assembled first

First operation in fabricating a panel of truss was to assemble and tack weld the 17 component parts of each chord, and to accurately drill the $1\frac{13}{16}$-in. holes for the four chord-block bolts. Considerable emphasis was placed on locating these holes accurately, as they were used later for proper centering of the chords in the jigs during all assembly of a truss panel, including the drilling of pin holes in the male and female ends. Holes for sway bracing were drilled through $\frac{1}{2}$-in. plates welded between channels prior to placing the chords in the jigs.

Two chord sections were laid flat in an assembly jig with their flanges vertical. Jigs were built on heavy steel frames about knee-high and equipped with braces, clamps and centering pins so arranged that web members of the truss panel could be quickly assembled in correct position, ready for welding.

After the component parts of a panel were securely fastened in the jig, in a horizontal position, as much

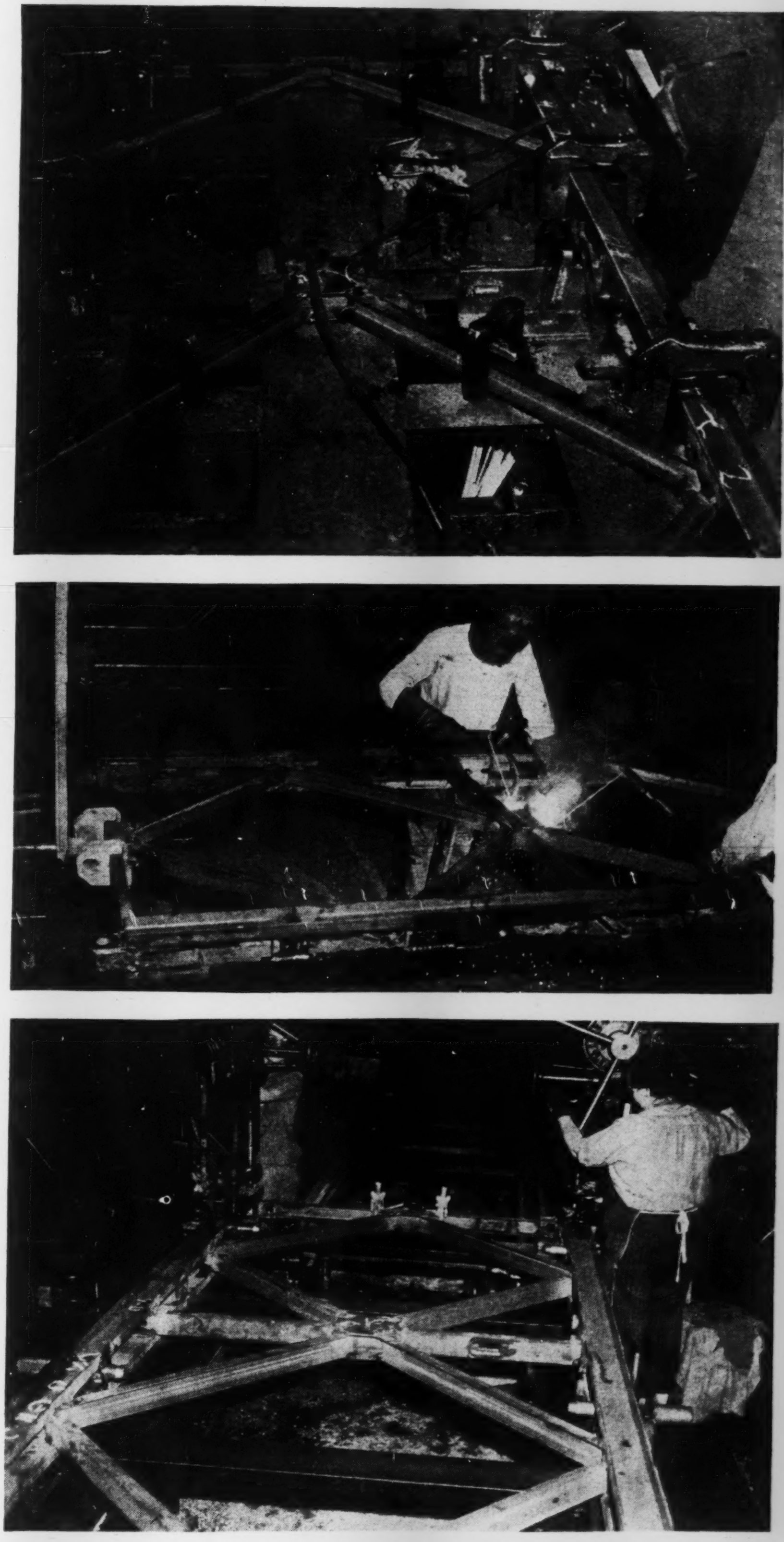


Fig. 2. Truss panels were assembled and partially welded in special jigs (top), moved by overhead conveyor to the welding bay where welding was completed (center), and on to the vertical drills (bottom) for precision drilling of pin holes.

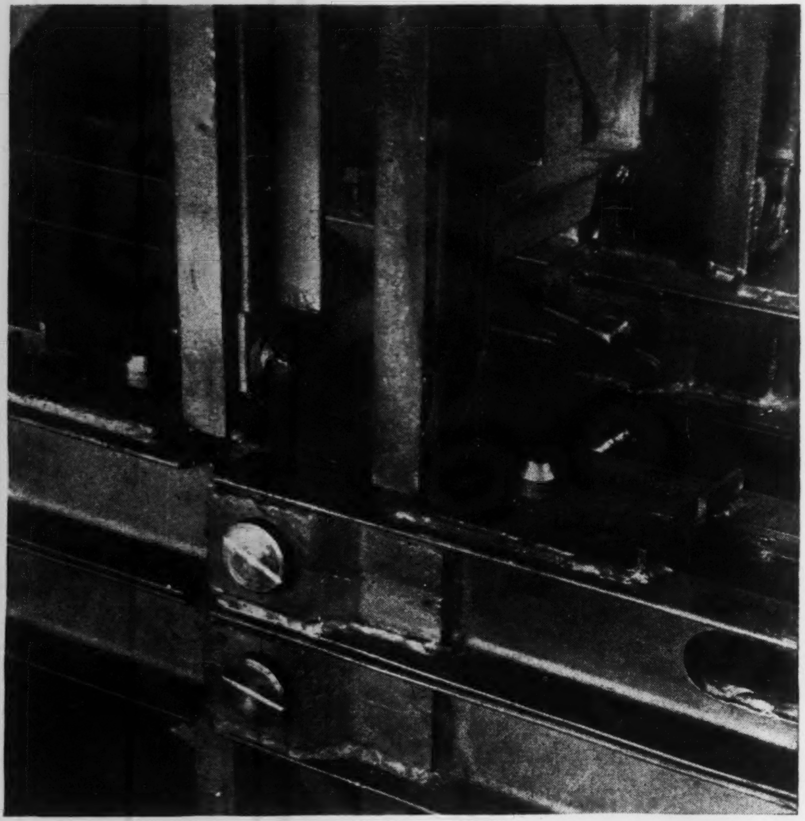


Fig. 3. Male and female ends of adjoining truss panels were pinned together with a large pin, while floorbeams were centered on tapered pins either side of the panel point, as shown in this close-up of the joint.

welding was completed as could be reached with down-hand welding. Special lifting trunnions then were attached to the end posts and to an overhead conveyor. Jig-braces and chocks were released, the truss panel was raised clear of the jig, turned over and moved into a welding bay where all welding was completed.

At this stage of fabrication the truss panel was complete except for drilling the pin holes and painting. Still attached to the conveyor, it was moved out of the welding bay and placed on a second jig for drilling the 1⅞-in. dia. pin holes in the ends of the chords.

As before, the panel was accurately positioned in the jig by centering pins engaging the previously drilled chord-block holes. The panel and jig were rolled by hand beneath two vertical drills which drilled the holes in the top and bottom chords at one end of the panel, then rolled forward 10 ft. to drill the holes at the other end. The panel was automatically positioned under the drills by steel stop-lugs on the stationary frame beneath the movable jig, and the panel was raised into correct position by compressed air for drilling the pin holes.

The final procedure was to return the completed panel and jig under the conveyor, remove the locking pins, attach the panel to the conveyor and move it into the paint booth where it was sprayed with two coats of paint. First coat was zinc chromate and final coat was Army grey. When the paint had dried, panels were bolted in bundles of six and loaded into railroad cars for shipment to some designated U. S. Army depot. Using only four assembly jigs, between 60 and 65 of the 10-ft. truss panels were fabricated in two 10-hr. shifts.

Matching British practice

Floorbeams, or "transoms" as they were called by the British, were steel beams, 10 in. deep, 18 ft. long and weighing 26 lb. per lin. ft. Although no serious problems were involved in matching shop details being used at that time by the British, it was necessary to shear ⅝ in. off each side of both flanges of all floor beams for a distance of 6 ft. from each end. This permitted the erection of an American-fabricated floorbeam in a British-fabricated Bailey bridge.

Six 4-in. dia. holes were provided in the floorbeam webs to permit their being carried "on the double" by several combat engineers. Floorbeam flanges were stiffened with plate stiffeners welded to the web and flanges, and clips were welded to the top flange of the floorbeam to hold the stringers in place.

Stringers were 4-in. I-beams weighing 7.7 lb. per lin. ft., spaced 9½ in. apart and shop welded in groups of three. Channel diaphragms were welded near the ends of stringers, and I-beams were welded at the one-third points. The middle stringer of each group locked into the clips on top of the floorbeams. Both flanges of this member required some shearing for a short distance at the ends to fit into the floorbeam clips, which followed the British design. The two outside stringers erected in each panel of the bridge had steel-plate "buttons" welded to the top flange every 9½ in. to hold the timber flooring in place.

Timber flooring

Although the bridge flooring, or "chess" as designated by the British, was not fabricated in the structural shops, its details and dimensions are significant. Treated timber flooring was cut 11 ft. 11 in. long, with a tolerance of plus or minus ⅛ in. They were dressed on four sides to a 2-in. depth and an 8¾-in. width, with a plus or minus $\frac{1}{16}$-in. tolerance.

A 6¾-in. length at each end of the flooring was dapped to a 6⅝-in. width with a tolerance of plus zero or minus ⅛-in., to fit between the stringer buttons. End-splitting of timbers was prevented by inserting two ⅜-in. bolts in $\frac{7}{16}$-in. prebored holes near the ends of stringers. Both the head and the nut of each bolt were countersunk in the sides of the floor planks.

No rivets or bolts entered into the erection of either the floorbeams or stringers. Floorbeams were spaced 5 ft. apart and bore on top of the bottom chords. They were fabricated long enough to engage all six chords in a triple-truss layout. All floorbeams were held in correct position in a completed bridge by two ingenious devices. One was a tapered pin plug-welded in the bottom chord of each truss, and extending 1 in. up into holes drilled into the bottom flange of the floorbeam on its centerline. The other was a J-bolt clamp hooked under the bottom chord and over the floorbeam with a hand screw bearing on top of the flange.

Steel guards replace timber

Fifteen lines of stringers extended throughout the bridge. They rested on the floorbeams and carried the 2x3¾-in. timber flooring which was laid flat. Originally, the Bailey bridge had timber felloe-guards at the ends of flooring, bolted to the outside stringers. But these felloe-guards were replaced later with steel plate "riband" guard rail assemblies anchored to the flooring and outside stringers with a special J-bolt clamp.

Maximum monthly production of the Ceco Steel Products Corp. reached twelve 150-ft. spans made up of double trusses each side of the roadway in a double-tier layout. Material also was furnished for a sidewalk on each side of the bridge, and for two 20-ft. approach ramps of the same general design as the stringer system. There were about 75 tons of steel in such a structure, which was furnished and fabricated at a cost of $0.125 per pound.

J. P. Arens, works manager, in direct charge of all fabrication, devoted considerable time and effort in developing the special jigs and assembly line used in fabricating the Bailey bridge. R. J. Anen is assistant works manager at Ceco, Otto Strunc is superintendent of the bridge department and R. Janda is chief mechanical engineer.

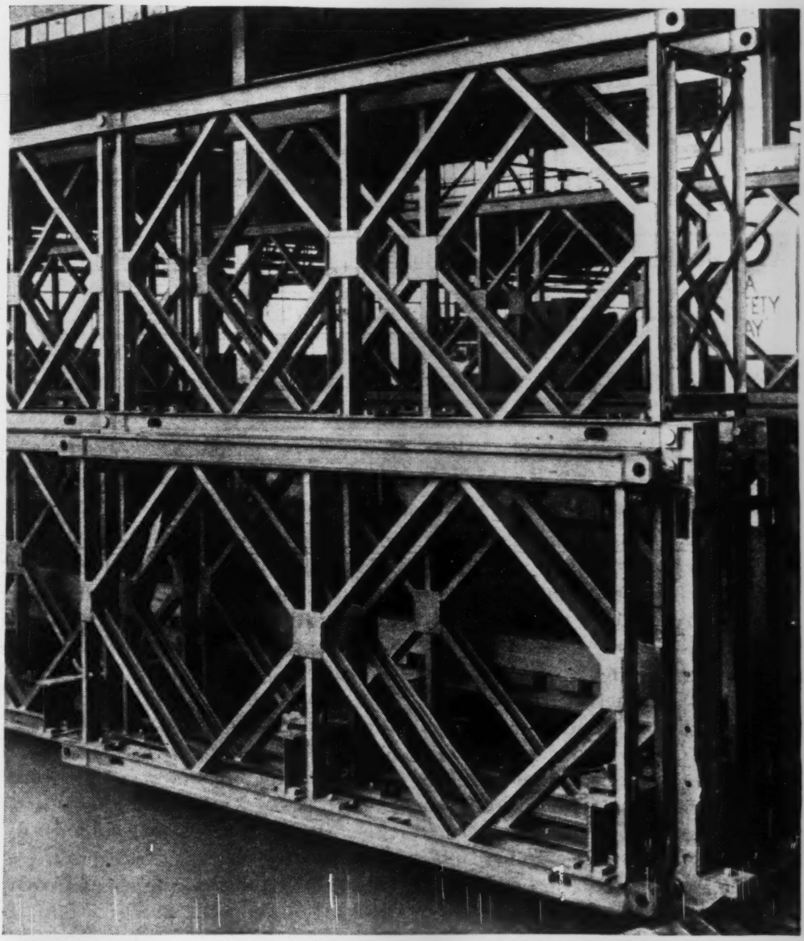


Fig. 4. Completed assembly of a Bailey bridge showing floorbeam connections and other details. American and British members are interchangeable.

Tax on Utilities to Finance Postwar Construction

A 10 percent tax on local utility services will help finance a seven-year $1,688,000 postwar improvement and maintenance program in West Palm Beach, Fla., the International City Managers Association reports.

The new tax, provided by ordinance and approved by the voters, applies to sales of electric, gas, water and telephone service and will bring in $175,000 a year. The tax will be added to monthly utility bills—10 percent on each bill up to $25, 5 percent on the next $50 and 1 percent on the remainder of the charge over $75. It is estimated each family will pay from 75c. to $1.50 a month.

Utility companies are required to collect the tax with bills for service; any company failing to collect the tax is liable for the amount due. Any consumer failing or refusing to pay the tax may be fined not more than $100, or jailed for a maximum of 10 days, or both. Utility companies must keep complete records for inspection by the city and turn tax revenues over to the city every month to be credited to the general municipal fund.

Included in a postwar plan, which also was approved by voters, were a schedule of specificc projects to be undertaken.

Estimates show the city probably will spend $558,000 for postwar projects the first two years after the war. During this period the utility tax of $175,000 a year will be supplemented by $208,000 the city accumulated as a result of abnormal tax collections and curtailed operations in recent years.

The seven-year program will be financed from current revenues, and the city commission will review the program annually. The city manager, the city planning board and department heads will make studies and prepare a schedule of priorities for each succeeding year, the city managers' association said.

Upstream Interferences a Factor In Interpreting Gaging Records

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***Contents in Brief**—Experience in Maryland shows that upstream diversions, impoundments and additions are of such magnitude as to seriously affect downstream flows during drought periods, and indicates that storage required to maintain a unit draft per sq. in. is less for small drainage areas than for large ones. Desirability of more gaging stations on each stream is indicated.*

STREAM GAGING RECORDS constitute a valuable aid in determining policies regarding regulation of water use. Especially is this true in sanitary control of streams where extreme low-water flows may necessitate rigid requirements in the matter of sewage and industrial waste disposal. In many cases, however, stream gaging records alone do not give the complete picture of flow variations, since withdrawals, diversions and regulation of upstream reservoirs may have a marked effect on the smaller flows.

Excellent examples of this effect are seen in the gage records of some of Maryland's streams where many of the water uses pre-dated existing laws or regulatory measures and others were instituted in compliance with specific laws for a particular use. These intermingled uses make it almost impossible to find locations for basic stream flow gaging stations not influenced by upstream activities. Therefore, corrections must be made in the records for stations so affected.

Low 1930-31 flows used as index

With the possible exception of 1869-70, for which no gage records and only fragmentary rainfall data are available, 1930-31 is the most intense prolonged drought period on record. Low flow records for that period are considered, therefore, the basic index for all problems in stream sanitation and power installations.

One valuable aspect of the present records, so far as low-flow data in Maryland streams is concerned, is that 21 of the existing 48 stations were in service prior to the 1930-31 drought. Of the 21 stations in service during this drought period, ten were subjected to upstream flow interferences.

A typical example of these interferences is seen at Hagerstown (Fig. 1) where the city draws a major portion of its public water supply from the Potomac River at Williamsport, above the Shepherdstown gaging station, and discharges treated sewage into Antietam Creek upstream from the gage at Sharpsburg. Diversions of 6 mgd. during the 1930-31 drought amounted to only 3 to 4 percent of the minimum daily flow at Shepherdstown, but these same diversions discharged as sewage represented 18 percent of the low flow at Sharpsburg.

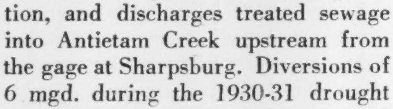


Fig. 1. A typical upstream interference with gaging records is this 6 mgd. water supply diversion with sewage discharged to another stream.

Another typical example is shown in Fig. 2. Here the Stony River reservoir of 1,980 mg. capacity is owned by a private industry, and from it up to 100 mg. or more are released to supplement low flows in the Potomac River upstream from the industrial plant and, incidentally, upstream from the Bloomington gaging station. This gage and others downstream, therefore, do not record true river flows. During periods of let-down they record the influence of let-down quantities, which diminish in magnitude as they progress downstream. During periods of no let-down the true recorded flow is less than normal by the amount being impounded by the dam.

For this reason certain adjustments must be made before flow data as recorded at the gaging stations along this river can be compared to each other and to other stations similarly situated but otherwise not modified.

The gaging station at Cumberland was influenced, up to November, 1935, not only by the operation of the Stony River reservoir, but also by the city of Cumberland, which secures its water supply from two reservoirs on Evitts Creek. During the drought of 1930-31 amounts up to 10 mgd. were drawn from Evitts Creek and discharged as sewage and industrial waste into the Potomac River ahead of the gaging station at Cumberland.

Also, the records of the U. S. Geological Survey indicate that during the drought some Potomac River water was diverted from above the gaging station to serve the Chesapeake and Ohio Canal.

Also shown in Fig. 2 is the location of the Savage River Dam (*ENR* Sept. 7, 1939, vol. p. 314). Construction on this dam, started in 1939, was suspended in 1942. No doubt scheduled for completion as a postwar project, it will impound 6,500 mg. and will be used exclusively to release water during periods of low flow along the upper reaches of the Potomac River.

This will further complicate stream flow calculations at existing and any new gaging stations below this location. Other minor adjustments in flow data are necessary for the gaging stations shown in Figs. 1 and 2; however, those cited suffice for the purposes of this discussion.

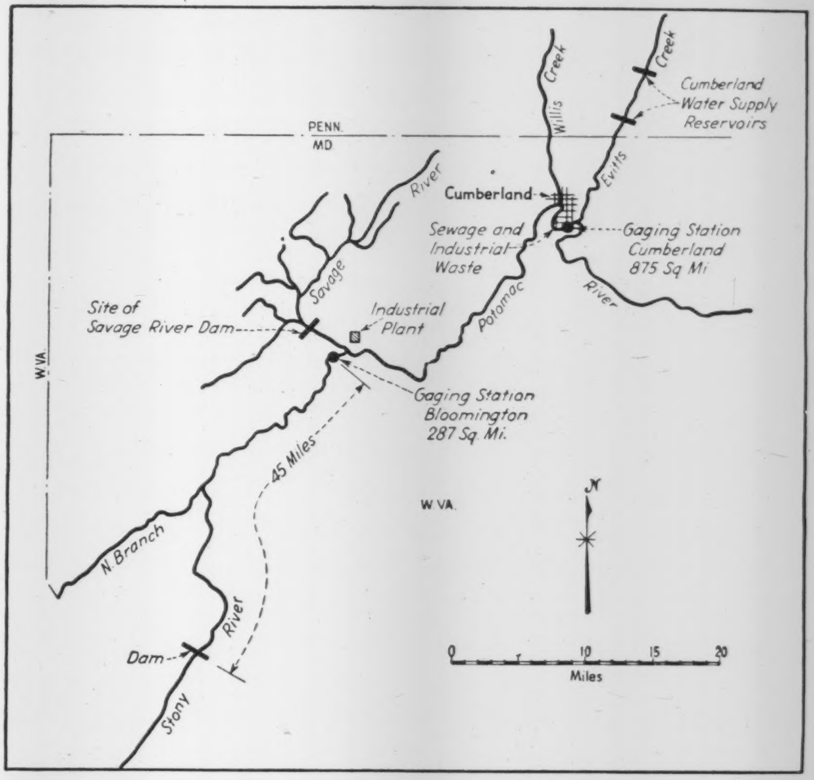


Fig. 2. Augmentation of low river flows by releasing 100 mgd. from impounding reservoir affects some gages, while a 10 mgd. addition affects others on the upper reaches of the Potomac River.

Data reduced to comparable base

From the daily records already available many detailed calculations have been made in order to evaluate the flows at the numerous gaging stations, one to the other, especially for the 1930-31 drought period. This has been done using flow in thousand gallons per square mile per day as a common denominator.

These data have been corrected for diversions and additions, when feasible, and arranged in various chart and tabular forms such as mass diagrams, draft storage curves and those showing frequency distribution of flow.

One interesting observation made from the unit draft storage curves is the relationship between storage requirements, based upon these data, for each of several stations on the same stream. Three such curves for the Potomac River (Fig. 3, left) indicate that less storage is required to maintain a unit draft per square mile for the smaller drainage areas, based upon data for the 1930-31 drought, than for the larger ones.

Small area flows more dependable?

The interference is that a smaller portion of a watershed is more dependable than a larger area. This seeming paradox is contrary to the more or less accepted practice of prorating stream flows by tributary areas. Such a deduction, however, may be consistent with the laws of probability whereby a more uniform but lesser flow obtains for larger drainage areas.

In Fig. 3, right, are shown two curves for gaging stations on the Patapsco River, one with a drainage area of 91 and the other of 165 sq. mi. Although the curves are closely parallel, the smaller drainage area again indicates a slightly less storage requirement. Such data conclusively indicate the desirability of more gaging stations on the same stream, especially for the smaller critical areas of possibly 5 to 10 sq. mi.

With more data from numerous stations on the same stream it may be possible to establish a definite relationship between the safe minimum yield of various drainage areas, thereby eliminating the error involved in pro-rating flows.

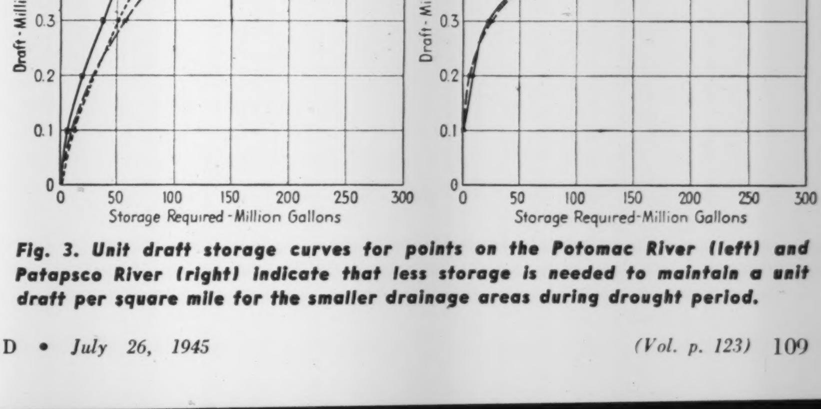


Fig. 3. Unit draft storage curves for points on the Potomac River (left) and Patapsco River (right) indicate that less storage is needed to maintain a unit draft per square mile for the smaller drainage areas during drought period.

Increasing Traffic Capacity of Streets By Simple Safety Methods

SINCE the substitution of trolley buses for streetcars in Seattle some years ago that city has brought about improvements in the traffic situation not foreseen at the outset. The trolley bus is little more than just another automobile so far as street congestion and traffic rules are concerned; it travels in any of the traffic lanes but, unlike the streetcar, it loads and discharges passengers at the curb. It is on this latter point that much of the improvement hinges.

Seattle has 1,300 miles of streets, of which about two-thirds are paved. About 80 percent of the traffic moves on 260 miles of the primary and secondary routes. In other words, 20 percent of the street mileage carries 80 percent of the traffic. Perhaps similar to other cities with industrial development moving ahead by leaps and bounds during wartime, this traffic situation has required careful study in recent years to obtain urgently needed capacity increases without major improvement projects which could not be undertaken in wartime. This necessary increase has been effected without the outlay of manpower or money such as would not have been in accord with the war effort. For the most part the improvement has been attained by very simple means.

The first step was removal of unused streetcar rails that were a menace by reason of the skid danger. Once the rails were out, drivers were able to uniformly space vehicles from curb to curb. This afforded an additional traffic lane, in effect, as was shown by a street cross-section published in *Engineering News-Record*, Feb. 10, 1944, vol. p. 202.

Besides the increased traffic capacity resultant from this additional traffic lane, there was considerable increase in average speed of traffic resultant from loading and unloading buses at the curb. Under the old regime when the streetcar stopped, the automobiles following could not pass. That is, there was not sufficient room between cars parked at the curb and the standing streetcar for an automobile to get by. Hence, following traffic simply waited for streetcars to load and unload, often missing the green light at the intersection in so doing because the cars stopped on the near side of the crossing. By discharging at the curb, the trolley buses leave the central lanes clear for a continuous flow of vehicles.

It was found that by stopping the trolley buses on the far side of an intersection instead of on the near side, as was the custom with streetcars, three important advantages are gained: (1) This plan permits undelayed right-hand turns by automobiles following the bus, (2) it enables the bus to pull up in a position actually parallel to the curb and hence does not leave the rear end projecting out to interfere with following traffic and (3) the gradual curve made in swinging in to the curb *beyond* an intersection causes much less wear on tires than does the quick, sharply curved turn required where the swing in to the curb is made before an intersection, immediately in front of a parked automobile. Safety is considerably enhanced by the far-side stop in that this plan prohibits a person from getting off the front end of the bus and crossing the street by going directly in front of the bus, thereby exposing himself to traffic in the center lanes of the street.

Finally, the most difficult rule to enforce, but the one which is a necessity in obtaining maximum use of street width, is to strictly prohibit curb parking of automobiles downtown during the rush hours. Enforcement of this rule makes available an additional lane on each side of the street.

Unloading at the curb instead of in the center of the street, thus allowing following automobiles to proceed continuously in middle lanes, increased the automobile capacity in Seattle streets 1.6 times. Putting a stop to curb parking further increased the traffic capacity to three times the old figure and stopping on the far side of cross streets has met with very general approval.

Peruvian Government Expands Public Works Program

The rapid forward strides which Peru is making towards industrialization, fuller utilization of its natural resources and higher standards of living are reflected in a report recently submitted to the Peruvian Congress by President Manuel Prado. The report summarizes the accomplishments of the Peruvian Ministry of Public Works, headed by Carlos Moreyra y Paz Soldan.

Encouraging progress has been made, according to the report, in linking coastal areas with interior river routes by means of "penetration highways." More than 750 miles of such highways have been graded, 121 miles widened and improved, 405 miles prepared for surfacing and 31 miles paved with asphalt. At the same time, 148 miles of dirt road has been built and 29,265 ft. of concrete and metal bridges and culverts completed. The 2,296-ft. Aguaytia River Bridge, largest in the country, was reported nearing completion.

Irrigation surveys have been completed by the Ministry of Public Works aimed at utilizing the Santa River to irrigate 112,000 acres of coastal wasteland, improve the irrigation of almost 100,000 acres of cultivated land, and provide the Department of La Libertad with a hydroelectric potential of 101,000 kw. by harnessing the 603-ft. waterfall about 37 miles from Trujillo.

Building construction undertaken by the Ministry of Public Works includes waterworks, low-cost housing projects for workers and government employees, sewage systems and many public buildings.

In anticipation of postwar demands, hotels have been built by the Government in Cuzco, Trujillo, Piura, Camana, Tumbes, Abancay and Puno, and other hotels are being constructed at Nazco, Huancavelica, Urubamba, Iquitos, Juliaca, Ayacucho, Cajamarca, Huaraz and Pucallpa and other places.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

A Successful Pipe-Climber

To climb the 2-in. dia. pipes set in concrete to mark points on snow courses in Oregon, which must be painted periodically, the portable climber illustrated was developed by the authors. It has proved so satisfactory that the device would appear to have similar applications on construction and related work.

The drawing shows details of the device. To facilitate passage of the climber over 2-in. dia. pipe couplings, the inside diameter of the split steel sleeve was made slightly greater than the outside diameter of any 2-in. pipe coupling likely to be encountered. Thus, the inner diameter of the split sleeve is considerably greater than the outside diameter of ordinary 2-in. iron pipe. Although this design gives a slight rocking motion to the climber as the weight of his body is shifted from one foot to the other, this feature does not reduce the safety of the climber.—R. A. Work and R. W. Childreth, *U. S. Soil Conservation Service and Oregon Agricultural Experiment Station, Medford, Ore.*

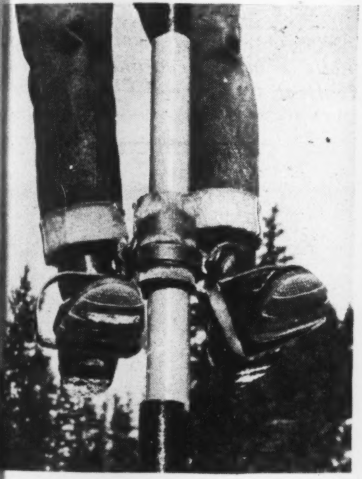


Fig. 1. Developed to aid in painting the pipe used to mark snow courses, climber, shown in use above, permits rapid ascent of small-diameter pipe. The worker's hands hold his weight while climbers are drawn up.

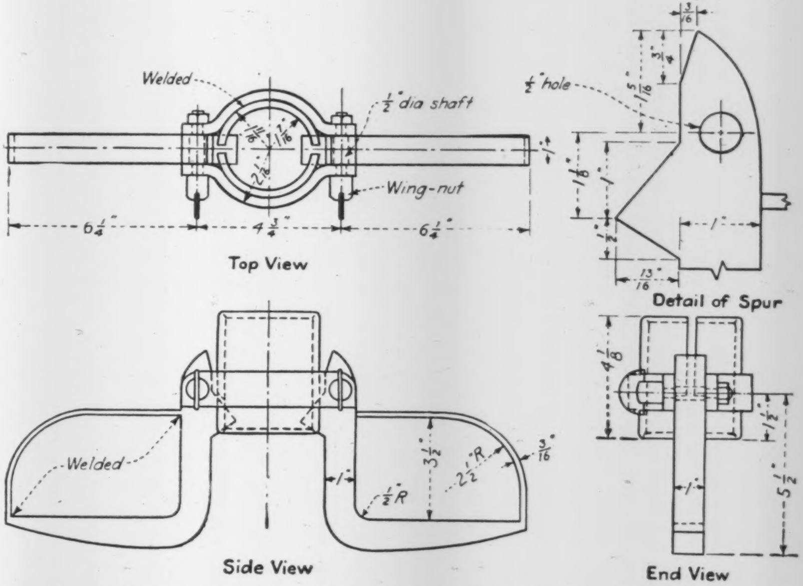


Fig. 2. Stirrups on each side of pole have a spur that cuts into metal when workers weight is on them. Movement up or down is possible by holding weight by hands to release spurs.

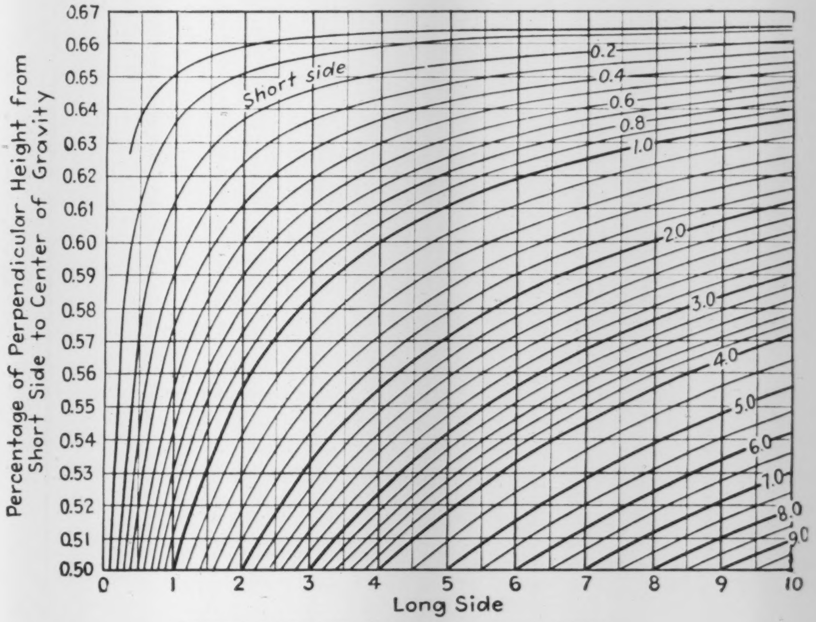
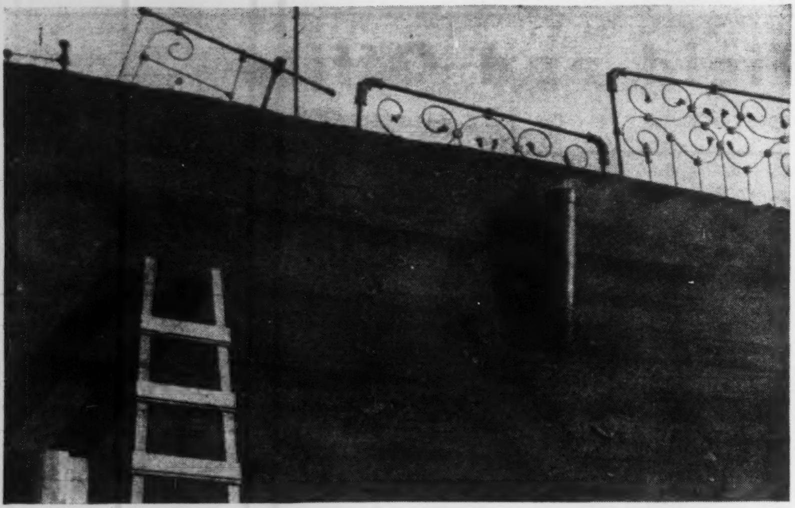


CHART LOCATES CENTROID OF TRAPEZOID

The center of gravity of a trapezoid may be found from the above set of curves in which the vertical ordinates, representing the length of the long side, intersect curves, representing the length of the short side, on horizontal ordinates giving the location of the centroid. Since multiplying both sides by a common factor does not change the location of the centroid, the chart includes all cases.



OLD BED FRAMES SOLVE REINFORCING PROBLEM

The end to which some home builders will go to circumvent material shortages is well illustrated by the above photograph. While driving recently on the outskirts of Yakima I was startled to see the collection of antique bed frames being used to reinforce a small concrete building. I could not resist returning to photograph the sad ending of beds that may have once proudly graced a bridal chamber.

A family was living in the bottom story (basement), when the picture was taken, the stove pipe shown being that for the kitchen stove.—H. T. NELSON, Construction Engineer, Bureau of Reclamation, Yakima, Wash.

Bond Stress Formula for Different Size Bars

Bond stresses in reinforced concrete when the bars are of unequal diameters cannot be obtained from the usual bond stress formula

$$u = \frac{V}{jd\ \Sigma o},$$

where Σo is defined as being the sum of the perimeters of all the bars at the section. This was explained in "Computing Bond Stress in Unequal Bar Layouts" by Roy E. Mc Fee, *ENR* Jan. 19, 1939, vol. p. 99. The determination of bond stresses when bars are of different size has been studied by several engineers, and at least one specification—that of the Canadian Engineering Standards Association—gives a formula for computing bond stresses in these cases. Although the question is still being studied, the results published so far can be given in a much simpler form than the C.E.S.A. formula.

In one method of calculation, the total shear V is proportioned between the bars in the ratio of their cross-sectional area to the total area A_s. The bond stress u_1 for the bars of diameter D_1 (area a_1, perimeter o_1) would then be given by the formula

$$u_1 = \frac{n_1 a_1}{A_s} \frac{V}{jd\ \Sigma o_1},$$

where n_1 is the number of bars of diameter D_1. The C.E.S.A. formula is

$$u_1 = u \frac{D_1\ \Sigma o}{\Sigma o D} = \frac{V}{jd} \frac{D_1}{\Sigma o D},$$

where ΣoD is the sum of the products of the perimeter and bar size for all the bars.

These formulas give identical results. Moreover, they can be transformed into the form

$$u_1 = \frac{V}{jd} \frac{1}{\frac{A_s}{a_1} o_1}:$$

In this formula, A_s/a_1 is the number of bars of diameter D_1 that would be required to make up the total cross-sectional steel area A_s. This result can be stated as follows:

When bars of different diameters are present at a cross-section, the bond stress on bars of any particular size is the same as if the whole steel area at this critical section were made up of bars of that size. Therefore, the bond stress formula may be written as

$$u = \frac{V}{jd} \frac{1}{No},$$

where N is the theoretical number of bars, each of the perimeter o, of which the steel area present at the critical section for bond may be assumed to be composed. N is obtained by dividing A_s by the area of one bar. This formula covers the case of bars of different size, as well as of bars of the same size. In order to simplify the work of the designer, tables of areas and perimeters for various combinations of bars should list instead of Σo the value No based on the largest bars of the combination. Then, the bond stress formula will give directly the maximum value of u.

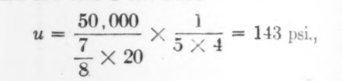
As an example of the use of this formula, consider a concrete beam reinforced with 4—1-in. sq. bars and 4—½-in. sq. bars at a section where the shear is 50 kips and the effective depth is 20 in. The total steel area A_s being 5 sq. in., the equivalent number of ½-in. bars is N = 20, and of 1-in. bars N = 5. The bond stress for the ½-in. bars is

$$u = \frac{50,000}{\frac{7}{8} \times 20} \times \frac{1}{20 \times 2} = 71.4 \text{ psi.},$$

and for the 1-in. bars

$$u = \frac{50,000}{\frac{7}{8} \times 20} \times \frac{1}{5 \times 4} = 143 \text{ psi.},$$

Ernest Zbinden, *Designing Engineer, Public Works Department, City of Montreal, Canada.*



MOUNT FOR GRINDER SAVES ONE MAN'S TIME

Overhead grinding in the 18-ft. dia. penstocks for the right powerhouse at Grand Coulee Dam formerly required the service of two men. Recently A. E. Kirstien, Bureau of Reclamation employee, developed the "pressure-jack" mount illustrated above and eliminated need for one worker.

WHICH Oil GOES INTO YOUR ENGINES?

A LAZY OIL

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DON'T be too quick to blame your engines if they're not turning in the kind of performance they should. It may be your oil is "laying down on the job." For an oil that's lazy . . . doesn't do its full quota of work . . . can cause plenty of engine trouble.

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CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

BRIDGE AND APPROACHES MASSACHUSETTS

OWNER: Massachusetts Dept. of Public Works, Boston.

PROJECT: Construction of bridge and approaches over Connecticut River near West Springfield and Agawam, Mass. Bridge is steel beam type, continuous spans, with concrete abutments on steel piles. Of the four spans, two are 100-ft. long, and two are 67-ft. long. Overall length 334 ft. Approaches to be bituminous macadam pavement. Includes all necessary drainage structures, sidewalks, and curbing.

CONDITIONS: Contractor to furnish all materials except those which are to be removed from present location and reset as designated. Time for completion: October 20, 1946. Rail and highway transportation facilities available to site of work. Wage rates are: skilled labor, $1.25 to $1.75 per hour; semi-skilled, 85c. to $1.50; and common labor, 90c.

BIDS: Eight bids were received June 5, 1945, ranging from the contract low of $203,377 to $269,451.

PARTIAL LIST OF BIDDERS:

1. Daniel O'Connell's Sons, Inc., Holyoke, Mass. (contract)	$203,377
2. Coleman Bros. Corp., Boston, Mass.	205.827
3. Cayuga Constr. Co., New York, N. Y.	227,746

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clearing and grubbing	0 5 ac.	$225.00	$200 00	$100.00
2. Roadway earth excavation	2,400 c. y.	.89	.50	.65
3. Rock excavation, Class A	50 c. y.	1.12	5.00	4.00
4. Unclassified excavation	5,300 c. y.	3.10	1.50	1.50
5. Trench excavation	660 c. y.	2.25	1.75	2.20
6. Class B rock excavation	200 c. y.	9.00	5.00	6.00
7. Rein. conc. surface excav	90 c. y.	2.25	5.00	5.50
8. Trees removed	8 ea.	28.00	13.00	15.00
9. Stump removed	1 ea.	17.00	13.00	20.00
10. Ordinary borrow	2,500 c. y.	.56	.65	.65
11. Gravel borrow	3,4 0 c. y.	1.35	1.00	1.50
12. Sand borrow	250 c. y.	3.90	2.00	1.60
13. Cinder borrow	750 c. y.	1.75	2.00	1.85
14. Stripping gravel pits	340 c. y.	.10	.10	.20
15. Scarifying and reshaping	200 s. y	.22	.50	.50
16. Fine grading, rolling and finishing	14,000 s. y.	.07	.08	.10
17. Crushed stone for base course	1,400 ton	1.92	2.50	2.00
18. Calcium chloride for surf. trtmt.	10,000 lb.	.03	.03	.04
19. Cr. stone for macadam surf	950 ton	2.42	3.00	2.25
20. Bitum. for macadam surfacing	9,500 gal.	.15	.13	.12
21. Bitum. for macad. surf. (seal)	5,500 gal.	.13	.13	.11
22. Cl. J. sheet asphaltic conc. (J-3)	240 ton	9.10	10.00	10.00
23. Oil treated stone	22 ton	3.42	5.00	7.00
24. Bitum. mat'l. for seal coat	340 gal.	.17	.13	.12
25. Cl. A cem. conc. masonry	525 c. y.	23.30	27.00	35.00
26. Cl. B. cem. conc. masonry	1,501 c. y.	15.80	24.00	28.00
27. Cl. C. cem. conc. masonry	18 c. y.	14.60	20.00	25.00
28. Cl. D. cem. conc. masonry	87 c. y.	38.00	35.00	50.00
29. Steel reinforcement, structures	152,000 lb.	.047	.06	.05
30. Structural steel	975,000 lb.	.078	0775	.08
31. Bituminous damp-proofing	1,670 s. y.	.11	30	.50
32. Field stone masonry in cem. mortar	45 c. y.	14.80	13.00	35.00
33. Riprap	1,300 c. y.	4.90	3.00	6.00
34. Remove present superstructure	Lump Sum	1,930.00	1,000.00	5,000.00
35. Metal bridge railings	588 l. f.	16.25	15.00	12.00
36. Steel piles	1,300 l. f.	2.80	3.50	2.50
37. Steel pile splices	5 ea.	112.00	40.00	25.00
38. Galvanized nose angles	4,400 lb.	.10	.13	.15
39. Catch basins	8 ea.	118.00	100.00	175.00
40. Special manhole	1 ea.	310.00	200.00	175.00
41. Catch basins, manholes or leaching basins adjusted to line or grade	9 ea.	11.00	25.00	10.00
42. Frames and grates or frames and covers removed and stacked	5 ea.	3.50	10.00	5.00
43. Furn. and install special 12-in. traps	4 ea.	8.00	30.00	50.00
44. 12-in. rein. conc. pipe	390 l. f.	1.31	1.75	2.00
45. 24-in. hvy. wt. cast iron pipe	90 l. f.	8.00	7.00	8.00
46. 10-in. vitr. clay or cem. conc. pipe	70 l. f.	.65	1.00	1.10
47. Sub-drains with 10-in. perf. bit. coated corr. metal pipe	170 l. f.	3.10	2.00	3.00
48. Hwy. guard bridge anchors	3 ea.	28.00	30.00	30.00
49. Individual posts	4 ea.	4.50	5.00	4.50
50. Hwy. guard Type (4x10)W1W	230 l. f.	1.70	1.50	1.75
51. Chainlink fence, remove and stack	90 l. f.	.56	1.00	.75
52. Chainlink fence, remove and reset	210 l. f.	.56	1.20	1.50
53. Gran. curb Type VA-3, straight	775 l. f.	1.85	1.60	2.00
54. As above, curved	330 l. f.	2.36	2.20	2.50
55. Gran. curb, Type VA, str., 6x11-in.	743 l. f.	1.65	1.60	2.00
56. Gran. curb inlets	7 ea.	22.00	20.00	75.00
57. Granite curb inlets (curved)	1 ea.	31.00	25.00	80.00
58. Gran. curb corners, Type B	15 ea.	16.00	15.00	20.00
59. Concrete edg., Type SFA straight	220 l. f.	1.45	2.00	1.2
60. As above, curved	170 l. f.	2.00	2.50	1.9
61. Curb, remove and reset	150 l. f.	.56	.60	1.9
62. Curb, remove and stack	450 l. f.	.34	.30	.8
63. Granolithic walks	150 s. y.	3.05	3.00	4.5
64. Bitum. conc. walk surface	50 ton	9.50	10.00	10.0
65. Cr. stone base for walks	120 ton	2.50	2.50	2.5
66. Bitum. for walk base (asph.)	950 gal.	.16	.13	.1
67. Traffic signal conduit, Type BF or CA	1,100 l. f.	.68	1.00	.5
68. Granite bounds (lettered)	8 ea.	19.00	13.00	20.0
69. Bounds, remove and reset	2 ea.	11.00	10.00	15.0
70. Peastone for driveways	40 ton	3.40	4.00	3.5
71. Lighting	Lump Sum	3,050.00	2,700.00	2,500.0
72. Stone steps, remove and reset	2 ea.	5.60	50.00	30.0
73. Loam borrow	500 c. y.	2.25	2.00	2.5
74. Seeding	2,300 s. y.	.06	.10	.1
75. Lawn sodding	370 s. y.	1.40	1.00	1.25

REPAIRING SEAWALL AND HIGHWAY MASSACHUSETTS

OWNER: Massachusetts Dept. of Public Works, Boston.

PROJECT: Rebuilding concrete seawall and resurfacing sections of Sea View Avenue in Oak Bluffs, Mass., with bituminous concrete pavement. Involves raising and restoring approximately 728 feet of sea wall, and reconstructing granolithic sidewalks and bituminous concrete highway damaged by hurricane.

CONDITIONS: Contractor to furnish all materials and complete work by June 23, 1945. Highway transportation facilities available. Wage rates are: skilled labor, $1.25 to $1.75 per hour; semi-skilled, 85c. to $1.50; and common labor, 90c.

BIDS: Six bids were received February 27, 1945, ranging from the contract low of $94,401 to $234,409. Contract awarded April 25, 1945.

PARTIAL LIST OF BIDDERS:

1. Berke-Moore Co., Inc., Brookline, Mass. (contract)	$94,401
2. M. F. Roach Co., E. Bridgewater, Mass.	97,26
3. Thomas Brothers, Boston, Mass.	97,39

Item	Quan	Unit Prices (1)	(2)	(3)
1. Unclassified excavation	600 c. y.	$2.50	$2.00	$1.00
2. Ordinary borrow	320 c. y.	1.00	1.00	1.50
3. Sand borrow for cover	30 c. y.	3.00	3.00	2.00
4. Loam or clay hardening	250 c. y.	2.65	2.00	2.00
5. Fine grading, rolling and finishing	2,200 s. y.	.05	.08	.10
6. Bitum. mat'l. for surf. treatment	1,000 gal.	.25	.35	.40
7. Class F. bitum. conc. pavement	530 ton	12.00	9.00	12.00
8. Timber piles	2,600 l. f.	1.50	2.50	1.50
9. Class C cem. conc. masonry	355 c. y.	30.00	30.00	30.00
10. Field stone masonry in cem. mortar	12 c. y.	20.00	25.00	25.00
11. Riprap removed and relaid	360 c. y.	5.00	8.00	8.00
12. 12-in. vitr. clay or conc. pipe	8 l. f.	1.00*	2.50*	1.00†
13. Unclassified excavation	1,700 c. y.	2.50	2.00	3.00
14. Ordinary borrow	3,400 c. y.	1.00	1.00	1.25
15. Sand borrow	200 c. y.	2.00	3.00	2.00
16. Sand borrow for cover	35 c. y.	3.00	3.00	2.00
17. Loam or clay hardening	450 c. y.	2.65	2.00	2.00
18. Fine grading, rolling and finishing	10,100 s. y.	.05	.08	.10
19. Bitum. mat'l. for surf. treatment	1,250 gal.	.25	.35	.40
20. Cl. F. bituminous conc. pavement	520 ton	12.00	9.00	12.00
21. Cl. B cem. concrete masonry	1,100 c. y.	30.00	30.00	30.00
22. Steel reinforcement for structures	19,100 lb.	.06	.10	.10
23. Riprap	190 c. y.	10.00	10.00	10.00
24. Riprap removed and relaid	50 c. y.	5.00	8.00	8.00
25. Catch basins	6 ea.	100.00	100.00	100.00
26. 12-in. rein. concrete pipe	170 l. f.	2.00	2.50	2.50
27. 6-in. light weight cast iron pipe	24 l. f.	1.50	5.00	1.50
28. Highway guard, Type (4 in. x 10 in.) W1W	120 l. f.	1.50	2.00	2.00
29. Chain link fence, remove and reset	240 l. f.	1.25	1.50	2.00
30. Two-rail iron fence, remove and reset	550 l. f.	1.25	2.00	1.00
31. Three-rail iron fence, remove and reset	700 l. f.	2.00	2.00	1.50
32. Concrete curb, Type VA	1,830 l. f.	1.50	2.25	2.00
33. Concrete curb inlets	3 ea.	25.00	50.00	30.00
34. Cl. F. bit. conc. walk surface	250 ton	12.00	12.00	12.00
35. Concrete sidewalk	800 s. y.	3.00	3.25	2.50
36. Lamp posts, remove and reset	3 ea.	25.00	100.00	30.00
37. Conc. fountain, remove and reset	Lump Sum	25.00	100.00	25.00
38. Wooden steps, remove and rebuild	Lump Sum	50.00	100.00	40.00
39. Concrete steps, remove and rebuild	Lump Sum	100.00	100.00	20.00
40. Remove hurricane debris	Lump Sum	250.00	300.00	100.00
41. Loam borrow	950 c. y.	3.00	2.50	2.50
42. Seeding	5,800 s. y.	.12	.10	.10

** Cement concrete pipe. † Vitrified clay pipe.*

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The Week IN ENGINEERING AND CONSTRUCTION

(Continued from page 76)

Court halts Cleveland's lake front development

Plans of the city of Cleveland, Ohio, to develop the lake front between Gordon Park and the downtown section for recreation, with lagoons, boating and yacht facilities, beaches, parks, parking areas, and similar things were stymied by a recent decision of Cuyahoga County Common Pleas Judge Alva R. Corlett, who declared unconstitutional the Fleming Act which the Ohio Legislature passed in 1917 to enable the city to trade lakefront lands to four railroads to insure getting a Union Depot at the foot of East Ninth Street. The contract never was made. This was the first time the act was questioned in court.

Judge Corlett said that act was an attempt by the state to give up public trusteeship in property held solely for lake navigation and commerce. Under state control, Cleveland may develop the lake shore for navigation, commerce and fisheries only, he ruled. He also declared unconstitutional the Abele act passed in 1925, amending the Fleming act to develop the lake front by assessing property benefiting by construction of city wharves, docks and piers, because its parent act was defective.

The state has title and right to underwater lands of Lake Erie starting at the natural shoreline as it existed in 1914 and including all land made since by filling, he ruled, but no owner of lands abutting the lake can be denied his right to access, he added.

Memorial Shoreway, N.E., built between E. 9th and E. 72nd streets, ostensibly to aid navigation, does not do so, but hinders it and denies to adjoining property owners their rights of access to the lake, he ruled. There may be suits for damages on that account, he said. The decision came in pleas of the city and Union Properties, Inc., owner of vacant land on the south side of Memorial Shoreway at E. 55th st., and the Union Salt Co., adjoining, to define their lakefront rights.

Judge Corlett's decision is a blow to the Cleveland Postwar Planning Commission, whose program calls for the expenditure of about $35,000,000 over a ten-year period, to carry out Planning Coordinator Proctor Noyes' beautifying project and plans of the city and state to construct a duplicate of the present four-lane boulevard which carries the bulk of traffic between downtown Cleveland and the residential sections in the northeast.

Because of the far reaching effects of the decision, City Law Director Lee Howley has announced the city will file an appeal to Judge Corlett's findings.

• • •

California legislature plans postwar building

California added about $125,000,000 to its postwar construction workpile through recent action of its legislature and changed its laws governing contractors and bidding on public works to conform to suggestions of the construction industry.

Principal postwar item was a $90,000,000 fund set aside for construction of either state or local public works. Actual appropriations are to be made at a special session of the legislative body to be called by Gov. Earl Warren, probably next winter.

Another act appropriated $12,000,000 for county roads to match federal funds, and $15,000,000 was set aside for improvement of California beaches and acquisition of park and playground sites.

Passage of the Community Redevelopment bill brought to California cities the power of eminent domain for use in acquiring blighted areas for redevelopment. Following the lead of 13 other states and working out its own legislation from the experience and court decisions of others, California thus opened up for private enterprise redevelopment those areas in its major cities which either are slums or are at present unused because of scattered ownership and unsuitable planning.

The legislature also created a new state board of paid members to integrate its water and flood control problems, the first step in a program of financing local additions to federal flood control funds authorized by the Congress.

Three bills, endorsed by the Associated General Contractors, the State Builders Exchange, the building and construction trades unions, and other elements within the industry, carry changes in the Contractors License Law and the so-called State Bidding Act.

The Bidding Act was amended to

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Practice makes perfect! To master the split-second technique of successful base-stealing, many a baseball player *practices* with a few ounces of LEAD in his shoes—deliberately handicapping himself during the training season so he will have a "plus" in speed for the pinches.

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Preload experience gained in hundreds of projects has made it possible to design with proper consideration of earth loads foundations, shrinkage, temperature differences, plastic flow, working stresses, and all other factors which go into this type construction, to your most exacting requirements.

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BOSTON WASHINGTON MONTREAL

make it unnecessary for general contractors to name in their bids on public works subcontractors for work amounting to less than ½ of 1 percent of the bid. The heretofore drastic 100 percent penalty clause of the Act was amended to 20 percent of the subcontract involved in the violation. The third principal change will permit substitution of a subcontractor when the one named in the bid fails or refuses to execute his contract, providing the awarding authority consents.

An amendment to the Contractors' License Law restored provisions classifying construction contractors. The classification was removed from the law in 1941 and put in the hands of the Contractors' License Board, leading to friction within the industry.

• • •

White River survey has been completed

A comprehensive survey of the White River and its tributaries in Arkansas and Missouri, in preparation for six years, has been submitted to the division engineer of the Southwestern division U. S. Engineers, at Dallas, Tex., by Col. Roy D. Burdick, district engineer at Little Rock, Ark.

The report considers navigation, flood control, hydroelectric power, irrigation and other water uses. Specifically it considers supplementing the present system of approved reservoirs, Table Rock, Bull Shoals, Water Valley, Bell Foley and Greet's Ferry, with additional multiple-purpose reservoirs for flood control, hydroelectric power, and other purposes, and also considers several projects for local flood protection and drainage in addition to those already authorized.

The report also considers the possibility of furnishing from the White River a supplemental water supply for irrigating rice lands at Grand Prairie where there is a serious water supply problem.

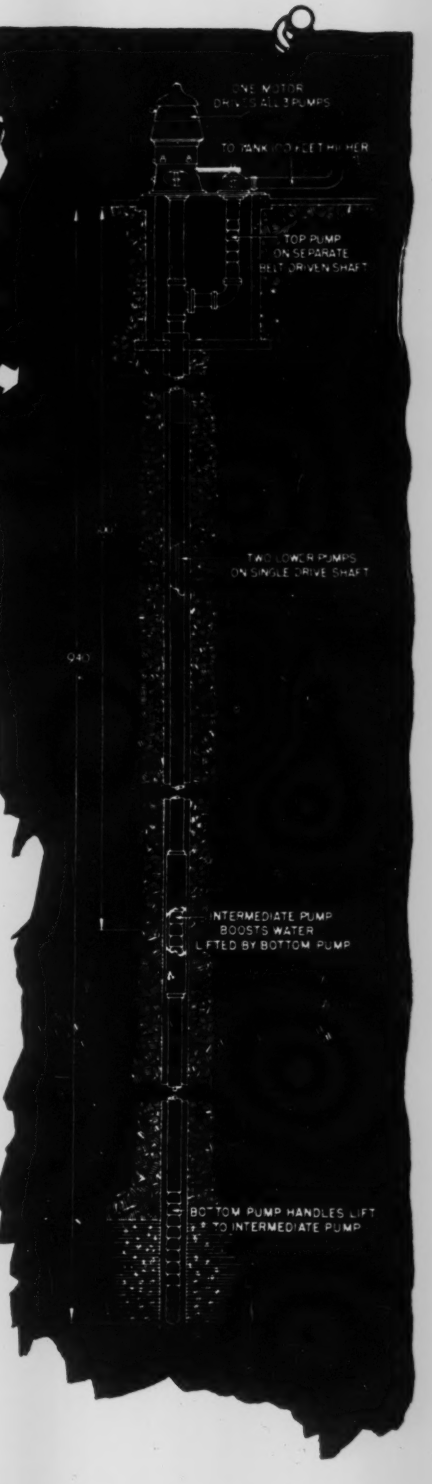
The division engineer at Dallas will review the report and make his recommendation to the Chief of Engineers, Lt. Gen. Eugene Reybold, Washington, D. C. It will then be referred to the Board of Engineers, Rivers and Harbors, for review and recommendations. After the Chief of Engineers has received the recommendations of the board he will submit a draft of the report to the governors of Arkansas and Missouri for their review and comments. The final report will then be submitted to Congress by General Reybold. Colonel Burdick's report and recommendations will not be available for release to the public until Congress has the complete text.

Another page from the widespread experience of Fairbanks-Morse pump engineers!

HOW 3 PUMPS 2 SHAFTS 1 MOTOR were UNITIZED to solve a tough military problem!

IMAGINE the hydraulic skill necessary to combine an integral electric drive, a belt drive, 3 pumps totaling 59 stages and 890 ft. of column pipe and shafting into *one* smooth-running pumping unit . . . and at the same time solve one of the toughest lubrication problems ever put to a pump manufacturer!

Yet that's exactly what Fairbanks-Morse Pomona engineers did to meet an urgent water problem at a vital military base in the Pacific war zone. And even that is only part of the story, for the bottom pump on this installation is located *almost a thousand feet* through flint-hard rock from the motor that drives it . . . and the unit had to deliver 275 gallons per minute into a tank another 100 feet *above* the motor. That's an engineering job PLUS!


ONE MOTOR DRIVES ALL 3 PUMPS
TO TANK 100 FEET HIGHER
TOP PUMP ON SEPARATE BELT DRIVEN SHAFT
TWO LOWER PUMPS ON SINGLE DRIVE SHAFT
940
INTERMEDIATE PUMP BOOSTS WATER LIFTED BY BOTTOM PUMP
BOTTOM PUMP HANDLES LIFT TO INTERMEDIATE PUMP

The situation . . .

A large dependable water supply was needed at this base. To reach it almost a thousand feet of hole had to be drilled vertically through flint-hard volcanic rock—rock so hard the hole had to be kept as small as possible to make the job feasible. Yet the great depth of the well called for a man-sized pump to go into that hole—enough pump to lift the weight of a thousand foot column of water at a rate of 275 gallons each minute!

How it was solved . . .

After studying the job, Fairbanks-Morse Pomona engineers decided on a 59-stage vertical turbine pump to meet the hydraulic requirements. But instead of putting this one large pump at the bottom of the hole, it was divided into three smaller units—one at the bottom (some 940 ft. deep), another midway, and the third at the surface. By thus dividing the job, size of the drive shaft and column pipe was substantially reduced because only a portion of the total power required for the pumps now had to be transmitted the full depth of the hole.

Then these engineers pulled another trick from the hat. To further reduce loads on the main shaft and also increase flow clearances, *the top pump was set off to one side on its own drive shaft and powered by a belt drive from the* same *motor that handles the other two pumps!*

Many important advantages resulted from this unique solution. First, the small hole requirements were fully met—a notable achievement in itself. Second, although almost a thousand feet separate top and bottom units, ONE motor drives *all three* units for synchronized operation and maximum ease of control. Third, since drive-shaft power losses vary approximately as the *square* of the shaft diameter, by reducing the shaft size very important power savings were effected, thrust bearing loads reduced, friction losses minimized and unusually high overall efficiencies achieved!

This is typical of the engineering "know how" that goes into all Fairbanks-Morse and Pomona Turbine Pump installations. Perhaps this unusual pump knowledge can simplify your water-moving problems. A letter, wire or phone call to your nearby distributor places this widespread experience at your service without obligation. Fairbanks, Morse & Co., Chicago 5, Illinois.

Write for Bulletin No. G-75!

For smaller gallonage applications ask about Fairbanks-Morse Westco Pumps — products of the same outstanding pump skill!

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New Aids to the Constructor

All-Position A-C Electrode

The use of A-C welding, particularly for vertical and overhead work, will be furthered by an all-position A-C electrode capable of producing highest quality weld metal. The new electrode includes an arc pacifier that prevents excessive spatter loss during the negative half cycles and an arc stabilizer to aid in reestablishing the arc after each current zero.

For best performance on vertical and overhead arc welding, a high-organic electrode coating is used. This coating provides an envelope of burning gas that keeps the oxygen and nitrogen in the atmosphere from contaminating the weld metal. This type of coating leaves but a scanty slag over the deposited metal that does not interfere with welding.—*Westinghouse Electric & Mfg. Co., 306 Fourth Ave., Pittsburgh 30, Pa.*

• • •

Current and Voltage Reader

Contained in the sturdy, compact case of a new instrument, the Voltammeter, Model 601, are an A-C voltmeter and an A-C ammeter, ready for instant use. The ammeter measures from 0.2 to 500 amperes in eight current ranges; the voltmeter measures from 30 to 600 volts in three ranges, and can also be used on D-C at these ranges.

An inserted primary current transformer with 8 ft. secondary leads facilitates the measurement of current on the 0-100, 0-250, and 0-500 ampere scales without subjecting the meter to the stray magnetic fields. The meter can be located where it can easily be read, regardless of the current transformer's location. The range selector switch on the panel permits quick reading of currents. Large instant reading scales have white backgrounds with figures in jet black, covered by glass, and mounted at rear of panel. The strong metal case is provided with a stout carrying strap.

This instrument, packed for shipment, weighs 25 lb.; it is very useful on construction for determining power require-

SAVE PRECIOUS MAN HOURS! SPEED ALL REPAIR WORK!

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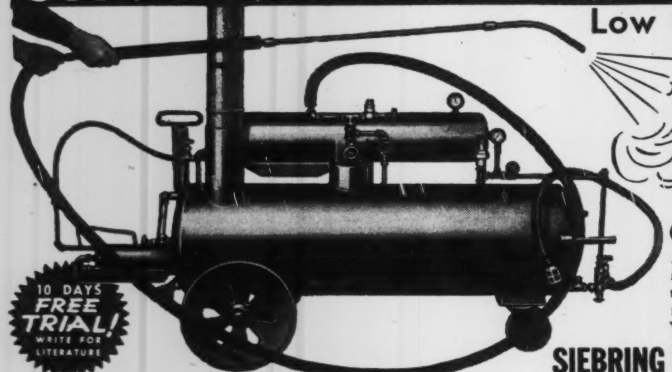

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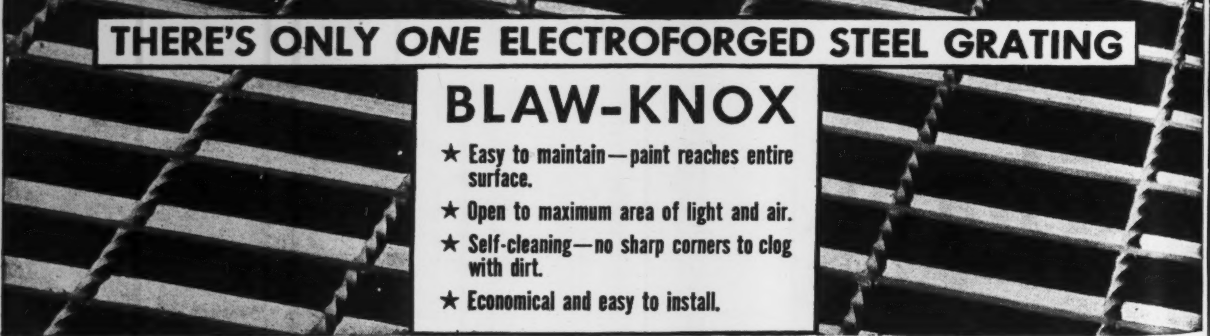

THERE'S ONLY *ONE* ELECTROFORGED STEEL GRATING

BLAW-KNOX

- ★ Easy to maintain—paint reaches entire surface.
- ★ Open to maximum area of light and air.
- ★ Self-cleaning—no sharp corners to clog with dirt.
- ★ Economical and easy to install.

BLAW-KNOX DIVISION of Blaw-Knox Company, 2001 FARMERS BANK BLDG., PITTSBURGH, PA.

MEN WHO OWN BLACK TOP PAVERS . . .

CHOOSE *Adnun* for OPERATING ECONOMY

EXPERIENCED MEN who have worked with all types of black top pavers . . . what do *they* think of maintenance costs on an Adnun Paver? Without exception they agree that the low maintenance costs of an Adnun are truly remarkable . . . far below the usual expenses which are encountered in other paving machines.

Reasons for this operating economy are not hard to find . . . Adnun Pavers are *built* to remain in top operating condition, with a minimum of attention. Example . . . the rigid cross-braced frame is more than adequate to absorb the strain of handling heavily loaded trucks . . . keeping bearings and shafts in line. Power take-off is through heat treated alloy steel bevel gears, fully enclosed and running in oil, mounted on anti-friction bearings . . . rear rollers are mounted in cast steel frames and the cutter bar is fully enclosed, can't be bent or warped. Trouble-free operation is the rule rather than the exception.

For further information on these economical pavers ask an Adnun owner, see your nearest Foote distributor or write direct.

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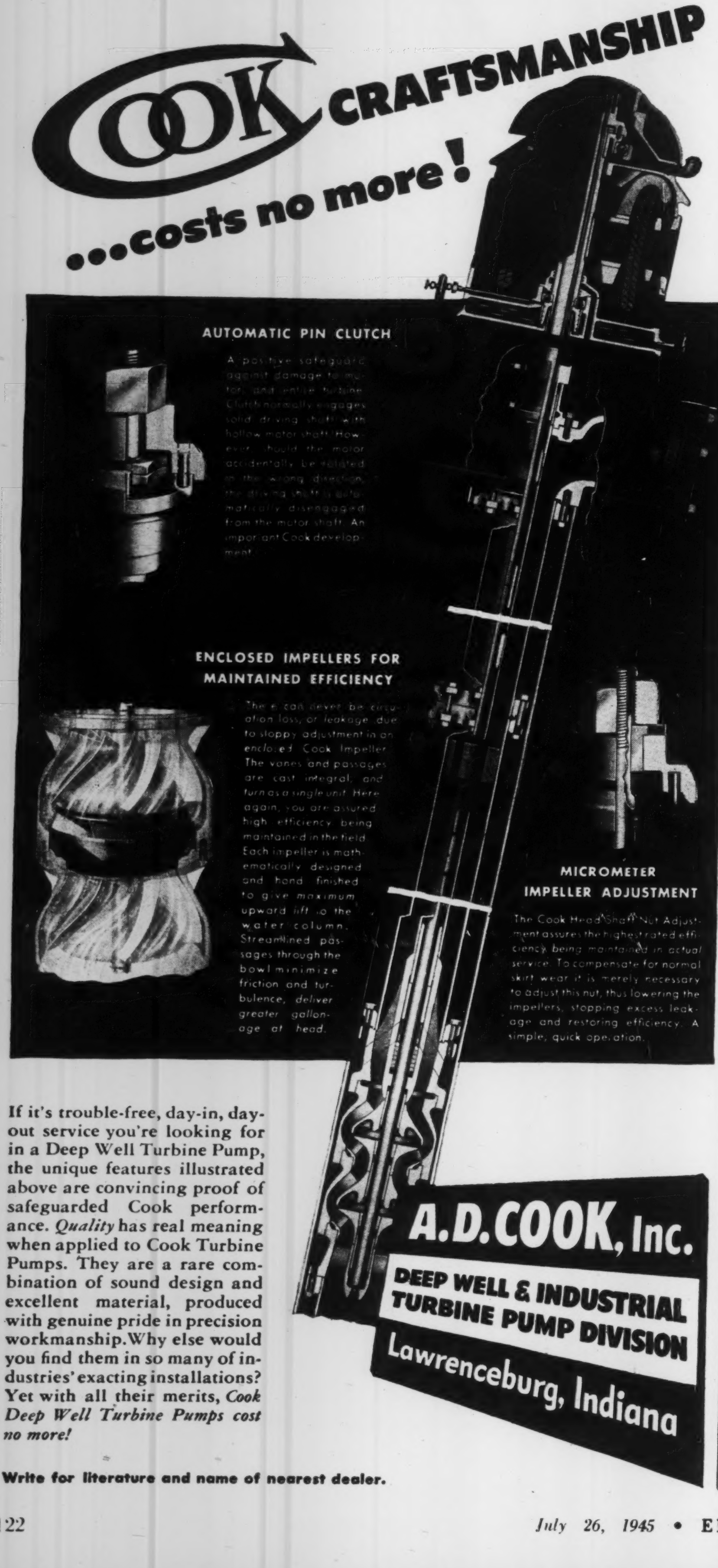

AUTOMATIC PIN CLUTCH

A positive safeguard against damage to motor, and entire turbine. Clutch normally engages solid driving shaft with hollow motor shaft. However, should the motor accidentally be rotated in the wrong direction, the driving shaft is automatically disengaged from the motor shaft. An important Cook development.

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There can never be circulation loss, or leakage due to sloppy adjustment in an enclosed Cook Impeller. The vanes and passages are cast integral, and *turn as a single unit.* Here again, you are assured high efficiency being maintained in the field. Each impeller is mathematically designed and hand finished to give *maximum* upward lift to the water column. Streamlined passages through the bowl minimize friction and turbulence, *deliver greater gallonage at head.*

MICROMETER IMPELLER ADJUSTMENT

The Cook Head Shaft Nut Adjustment assures the highest rated efficiency *being maintained in actual* service. To compensate for normal skirt wear it is merely necessary to adjust this nut, thus lowering the impellers, stopping excess leakage and restoring efficiency. A simple, quick operation.

If it's trouble-free, day-in, day-out service you're looking for in a Deep Well Turbine Pump, the unique features illustrated above are convincing proof of safeguarded Cook performance. *Quality* has real meaning when applied to Cook Turbine Pumps. They are a rare combination of sound design and excellent material, produced with genuine pride in precision workmanship. Why else would you find them in so many of industries' exacting installations? Yet with all their merits, *Cook Deep Well Turbine Pumps cost no more!*

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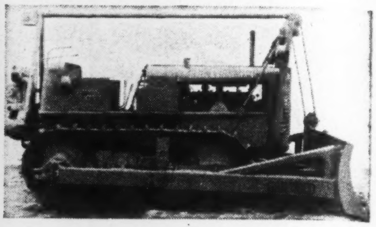
DEEP WELL & INDUSTRIAL TURBINE PUMP DIVISION
Lawrenceburg, Indiana

ment and voltage drop at machines.—*Associated Research, 231 South Green St., Chicago 7, Ill.*

• • •

Cable Dozecaster

A new dozer of angling blade type places the moldboard close to the radiator for good balance and easy pushing. A double trunnion on the main frame tilts the moldboard, taking weight from the front. There are no screw thread adjustments. Steel sheaves are hardened in the rope grooves and mounted on hardened and ground shafts with roller bearings.



The Dozecaster, mounted on an Allis-Chalmers HD14 diesel tractor, operates by a cable control unit in both single and double drum type.—*Gar Wood Industries, Inc., Detroit, Mich.*

• • •

Drill Grinder

A new precision-made fixture with a vertical post will simplify difficult grinding operations and eliminate guesswork, the manufacturer asserts. This device will accurately grind round shank drills in four point angles of 49, 59, 60 and 88 deg.; it will hold drills from 3/22 to 1 1/16 in. in diameter, and will sharpen short, medium and long twist drills from 1½ to 11 in. long.

Use of this grinder is said to give true drill centers, desired clearance and rounded points. Recessed angle guides eliminate the need for a protractor in setting for proper point tapers.—*A. D. McBurney, 939 West 6th St., Los Angeles 14, Calif.*

• • •

Waterproof Coating

Said to have about eight times the protective thickness of paint, a new waterproof coating, Liquinoleum, may be easily applied with brush or trowel to exposed surfaces. This resilient and elastic material is unaffected by acid fumes or most chemicals; it does not crystallize on setting, and the manufacturer states that even flame from a blowtorch will not cause it to burn, flow or run.—*Continental Asbestos & Refining Corp., 1 Madison Ave., New York 10, N. Y.*

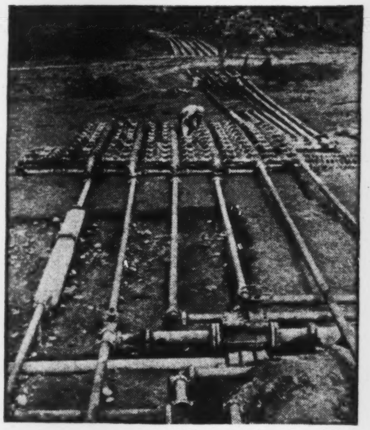
INVENTION FOR INVASION

Van Dyke Hill

TO THE average civilian—the man on the street in thousands of American cities and towns—little is known of the vital part played in the war by various inventions which have never shared the spotlight of front-page news with such dramatic developments as Radar, Superfortresses, LST Boats.

As an example of one of the unheralded inventions which has played an extraordinary part in the war, is a simple device called "Victaulic Pipe Coupling." It is an outstanding product of American ingenuity plus American engineering and financial vision—combined to bring this amazingly important device to a point where it has become a factor of definite necessity in the war effort.

The Victaulic Coupling provides means of joining together pipes of any dimension. It consists simply of a narrow metal housing, or collar, two small bolts and a self-sealing, flexible rubber gasket positioned within the collar under great pressure. Yet, simple as it is in design and operation, the device constitutes the quickest and most easily adaptable method known of joining pipe. Today, millions of such couplings have been supplied to our Army, Navy and Allies.


U.S. Army Signal Corps Photo

A manifold on the India-Burma-China 2,000 mile pipeline, which uses Victaulic Couplings.

To appreciate the important part played in the war by this single invention one has only to know that in North Africa, Italy, France, Burma and many of the Pacific Islands the Victaulic Coupling has been the solution to the great problem of laying thousands of miles of four- and six-inch portable pipe lines that were vitally necessary to military invasion.

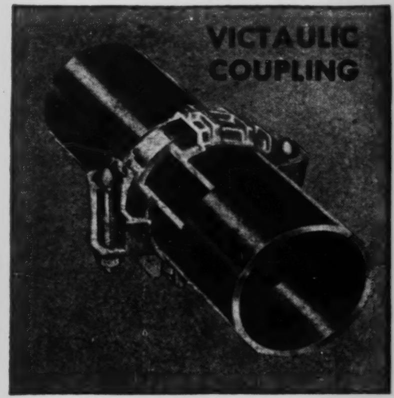
Confronted by a question of how to deliver quickly millions of gallons of gasoline and oil to airfields and motorized divisions operating hundreds of miles inland from available ports, our military authorities were given a demonstration and proof that gasoline pipes could be laid at the rate of 70 miles or more per day over hills and valleys, across rivers and even on lake bottoms. The device which made possible this great contribution to victory enables land crews to join sections of metal pipe faster than an Army can march and do so with a knowledge that every joint will have a flexibility which will permit the line to be laid on the surface of the ground and follow the contours thereof without danger of fracture.

U.S. Army Signal Corps Photo

Even though bombed, a Victaulic-coupled pipeline can be repaired in a matter of minutes.

The Army has said, "the Victaulic Coupling plays an important part in helping us to victory."

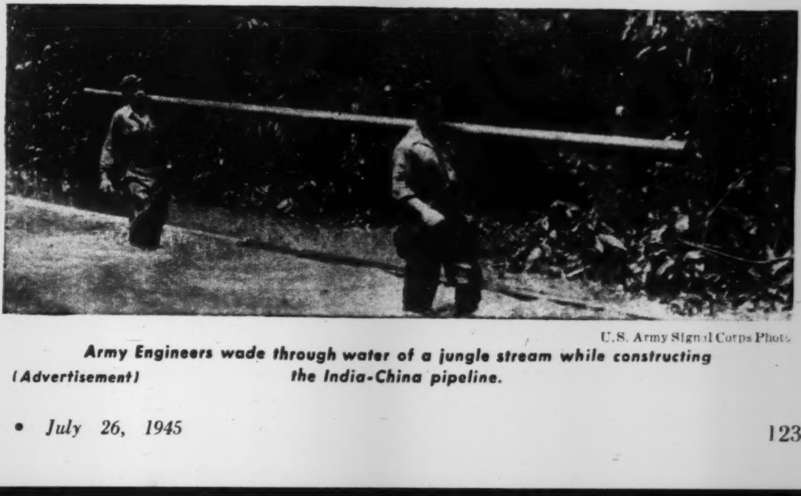
In hundreds of landing craft and other vessels of the United States Navy the Victaulic Pipe system has withstood the exacting demands of sea-going service. Used on the piping system of literally hundreds of these ships which carry important war material to all points of the globe, Victaulic has become well known to the Maritime Commission while almost totally unknown to our civilian population.



The great Kaiser ship building company stated, "deliveries of Victaulic Couplings have enabled us to deliver three more carriers during 1943 than our contracts anticipated."

During the dark days of the London blitz and subsequent attacks by robot bombs, many English cities were left without water and gas supplies. Thousands of Victaulic Couplings were rushed to England and used in joining temporary surface pipe lines to reestablish these vital utilities. A high official of the British Government has stated, "Victaulic Couplings should be given the George Cross for their major contribution during the Battle of Britain."

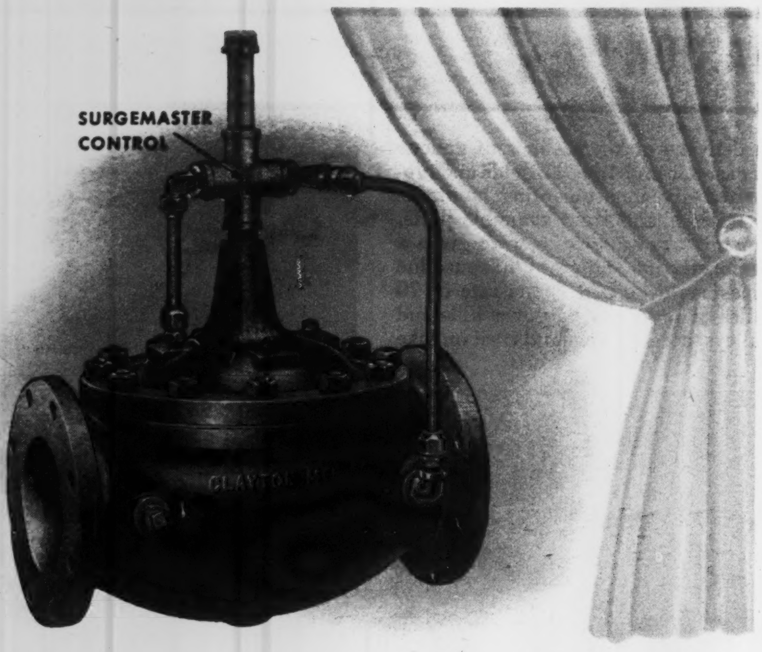
Here is inspiration indeed for the engineers, technicians and inventors of America, for here we find a product of American ingenuity modestly and without benefit of publicity or propaganda contributing immeasurably to the winning of the war.


U.S. Army Signal Corps Photo

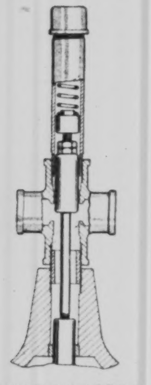
Army Engineers wade through water of a jungle stream while constructing the India-China pipeline.

Reprinted from "The Office Staff," N. Y., Feb., 1945

(Advertisement)



This new CLAYTON Check Valve positively prevents SURGE!


SURGEMASTER provides no-surge, no-slam control.

At last . . . the Check Valve that provides *controlled* surge protection. The Clayton HYDROMATIC Check Valve is entirely hydraulic in operation. It cannot slam. It positively prevents surge.

The HYDROMATIC Check Valve operates like a hydraulic door closer. In closing, the final action is throttled, thus effectively preventing surge. The opening operation is similarly controlled. Action in either direction starts by equalizing pressures gradually, without shock or water hammer.

Pressure to open and close the valve is directed through the SURGEMASTER Control which is adjustable to permit changing the speed of opening and closing to meet all conditions.

Write for Descriptive Bulletin • Representatives iu Principal Cities

VALVE DIVISION
CLAYTON
"Feather Touch" CONTROL

CLAYTON MANUFACTURING COMPANY, ALHAMBRA, CALIFORNIA

Manufacturers' Activities

Joseph L. Block, after two and a half years as deputy director of the steel division, War Production Board, is returning to his work as executive vice-president of the Inland Steel Co., Chicago, in charge of sales. Mr. Block conceived the idea of production directives, which had a key part in making the Controlled Materials Plan successful. Thus the steel division of the WPB utilized efficiently every ton of capacity of each steel producing company. These production directives were issued monthly and changed in accordance with the vital needs of the war effort. This plan is now working almost automatically and Mr. Block's resignation was prompted by a conviction that he could better serve by returning to his former duties as active head of Inland's sales department.

Lawrence F. Steele, formerly with Surface Combustion Co., Toledo, Ohio, has been named advertising and sales promotion manager of the American Floor Surfacing Machine Co., Toledo, maker of sanders, polishers, and portable electric saws. He had been with the latter firm for eight years prior to 1943.

Thomas Robins, Jr. has been elected president of Robins Conveyors, Inc., succeeding Thomas Matchell, retired. Mr. Robins is vice-chairman of the board of directors of the National Synthetic Rubber Corp., Louisville, Ky., president of the Hewitt Rubber Corp., Buffalo, N. Y., and a director of the Federal Reserve Bank of New York.

To help meet the ever-increasing demands of the armed services for pneumatic-tire and crawler mounted cranes, Bay City Shovels, Inc., Bay City, Mich., has planned a third plant expansion since Pearl Harbor. The new addition is estimated to increase output of both crawler and pneumatic-tire-mounted excavating and material handling equipment by 30%. The increased factory and office facilities, recently completed and put into operation, were designed

WHAT A GRIP!

Handle loads safely . . . economically with YELLOW STRAND *BRAIDED* SLINGS*

A lot of industries have taken a fresh hold on the sling question as a result of war production. And what a grip they get by using the adaptable Yellow Strand *Braided* Safety Sling! After handling just about every extreme in lifts — from multi-ton ship sections, tanks and guns to light-weight parts, jigs and crates — this improved type of sling is today primed to speed *your* assembly line, shop or field operations.

Tough Yellow Strand Wire Rope provides the sling's strength. The patented *braiding* adds flexibility, kink-resistance and a snug grasp on odd-shaped, rounded or slippery objects. The combined result is a time-and-labor-saving sling with less weight and bulk than chain of like capacity . . . with limberness well suited to former Manila rope jobs . . . with security that safeguards both employees and loads.

Properly fitted, Yellow Strand *Braided* Slings will give long-lived, economical service. Send details of your application now and let B & B engineers offer a recommendation. Broderick & Bascom Rope Co., St. Louis 15, Mo. *Branches:* New York, Chicago, Houston, Portland, Seattle. *Factories:* St. Louis, Seattle, Peoria.

RIGGERS' HAND BOOK FREE
Shows sling types, fittings, capacities. Write for your copy.

*PATENTS: U. S., 1475859, 1534671, 2142641, 2142642, 2299568; CANADIAN, 252874, 256068

ARMY E NAVY

BRODERICK & BASCOM

Yellow Strand

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80%+ humidity at 75° F., day in and day out, makes mighty rough conditions for ceiling and roof structures of wet-process plants. Plain lumber and other materials often rot, rust or crumble surprisingly fast. Wolmanized Lumber*, with Wolman Salts* preservative driven deep into the wood, is highly resistant to these wringing-wet atmospheres; fibre-fixation prevents its washing out or leaching, assures added years of service life.

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Billions of feet of lumber are still needed to fight the war. But war plants are part of our fighting force and lumber for critical plant maintenance and repair can be had. Write us for the names of suppliers who may be able to handle your order. Chemicals for treating are available at all our plants.

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and built by the Austin Co., Detroit, Mich.

APPOINTMENT of Walter M. Farnsworth as acting assistant manager of Republic Steel Corp.'s central alloy district at Massillon, Ohio, has been announced. He succeeds R. F. Horn, who died recently at Canton, Ohio.

PURCHASE of the business equipment and patents of two eastern brass companies has been announced by John C. Schelin, president of the Wooster Brass Co., Wooster, Ohio. The firms acquired are the William Yerden Co., manufacturer of hose clamps, Fort Plain, N. Y., and the M. H. Hart Co., manufacturer of fire hose nozzles, Hartford, Conn. It is planned to move equipment to Wooster and start production within 90 days.

T. U. BLAKE, has been named chief engineer of the B. F. Goodrich Co., Cleveland, Ohio, it has been announced by William L. Burt, general manager. Blake will be chief of Goodrich engineering staffs in Niagara Falls, N. Y., Louisville, Ky. and Akron. In addition he will oversee engineering work at company-operated synthetic rubber plants in the South.

W. B. PRINGLE, manager of Caterpillar Tractor Co.'s Berwick, Pa., office since June, 1944, has been appointed manager of the New York office, succeeding the late George E. Churchill. Don E. Kneer, successively export credit manager, domestic credit manager and supervisor of priorities in "Caterpillar's" executive offices at Peoria, Ill., succeeds Mr. Pringle as manager of the Berwick office. Mr. Pringle is a former company representative in the Scandinavian countries and had special assignments in North Africa, the Balkans and central Europe.

THE WOOD SHOVEL AND TOOL CO., Piqua, Ohio, has announced the appointment of William F. Ball, to the sales department. Mr. Ball is well known to the hardware distributing and industrial supply trade throughout New York, Pennsylvania, West Virginia and the New England states. In 1942 and 1943, he served the Army Service Forces as Senior Procurement Specialist for the Hardware Procurement Division at the Quartermaster Depot, Jeffersonville, Ind., He will act as field service manager for the sales department.

W. LYLE MCDANIEL, formerly chief engineer in charge of plant operations for the Massey Concrete Products Co., Chicago, has been elected vice-president succeeding Walter H. Robertson, resigned. Ross Clarke, assistant resident Manager has been appointed resident manager at Chicago.

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the STRUCTURAL STEEL for many important POWER PLANTS

For half-a-century, the skill, experience and progressive structural steel knowledge of the entire Fort Pitt Bridge organization has been called upon to design and fabricate the steel work for important industrial buildings, power plants, office and apartment buildings, government buildings, national, state, county and community bridges, throughout the country.

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Manufacturers' Publications

Modular Planning—A booklet contains a comprehensive study of modular planning in respect to the use of steel windows. It contains many drawings showing installation details.—*The William Bayley Co., Springfield, Ohio.*

Turbines, Pumps, Compressors, etc.—A new catalog covers a complete line of steam turbines, helical gears, centrifugal compressors, worm gear speed reducers, and oil pumps. In addition to briefly describing the equipment, this catalog tells somethings of the achievements of the company in the development of high pressure marine propulsion units and in the introduction of centrifugal pumps for water works service.—*De Laval Steam Turbine Co., Trenton 2, N. J.*

Water Works Valves—A folder describes a complete line of control valves including float, altitude, no-slam check and relief valves, pressure reducing regulators, backflow protection units and vacuum relief valves.—*The Clayton Manufacturing Co., Alhambra, Calif.*

Steel Fabrication and Erection—A brochure commemorates 50 years of progress in steel fabrication and erection. Pictured are various types of steel construction; movable bridges, railway bridges, concrete and steel bridges, maritime bulkhead plates, industrial construction, demountable V-type bridges and public buildings, institutions and memorials.—*North Pitt Bridge Works, Pittsburgh, Pa.*

Safety Treads—Complete information on safety treads and other metal walk-way safety devices is given in a new 16-page, 2-color, catalog.

Tables of standard maximum sizes and complete specifications facilitate selection of the proper tread. Details of installation on all types of cases are shown. Proper repair procedure is given for those interested in repairing old floor areas, stairs and ramps.—*Wooster Products, Inc., Wooster, Ohio.*

Super-charging—This booklet shows the advantages of positive displacement superchargers with a wide range of applications on all types of marine, industrial and automotive engines, either gasoline or diesel. Applied to internal combustion engines, it is said to assure higher overall volumetric efficiency by increasing the density of the intake charge . . . smoother, more uniform fuel combustion and the ability to burn more fuel when necessary for increased power.—*B-W Superchargers, Inc., Milwaukee, Wis.*

Painting Cement Floors—How the color of painted cement floors can be protected from wearing off prematurely and painted floor upkeep made easier is discussed in a new illustrated 6-page brochure, which shows various types of floors in eight different colors.—*Building Products Division, L. Sonneborn Sons, Inc., 88 Lexington Avenue, New York 16, N. Y.*

Blow and Spray Guns—An attractive 22-page booklet tells about rubber blow and spray guns and water savers, explaining the principle of valves which have only three working parts and give constant fingertip control of air or water under pressure without the use of levers, springs, push buttons, packings or screws. Elimination of small parts, the booket explains, reduces repair and replacement problems and results in low maintenance cost. Charts show the cost of air or water delivered through various sized orifices when uncontrolled.—*The B. F. Goodrich Co., Akron, Ohio.*

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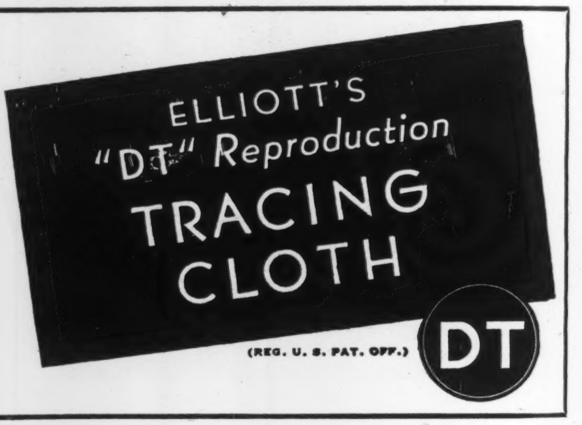

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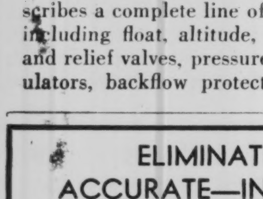
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Here's a sure, safe tonic for a listless drilling record: Bethlehem hollow drill steel.

For years, under its trade name Bethlehem Superior, it's been a favorite of both drill runners and blacksmiths. Reasons vary, but one of the commonest is, "Bethlehem Superior is easier to work with and doesn't need dressing as often."

The following features tell you why:

- ★ The steel is always true to size and makes up readily.
- ★ It is easy to heat-treat because it has a wide quenching range. This, in turn, results in better hardness.
- ★ It gives a shank that withstands the heavy battering of the drill piston.
- ★ The hole is smooth, true, and well centered. This means better fatigue-resistance, longer life.

Bethlehem Superior is a dual-purpose steel. Whether you thread it for detachable bits or forge on your own bits, it will respond equally well. Ask for it by name the next time you order drill steel.

BETHLEHEM SUPERIOR HOLLOW DRILL STEEL

★ BETHLEHEM STEEL ★

REALLY TURNIN' 'EM OUT, EH, BILL?
HAVEN'T I BEEN TELLIN' YOU, CAP? THIS BETHLEHEM SUPERIOR MAKES UP FASTER AND EASIER.

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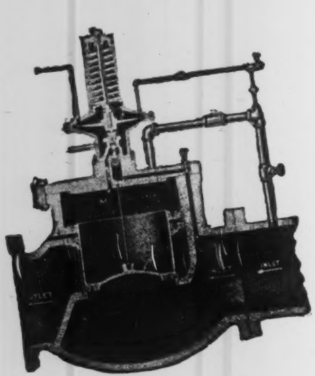

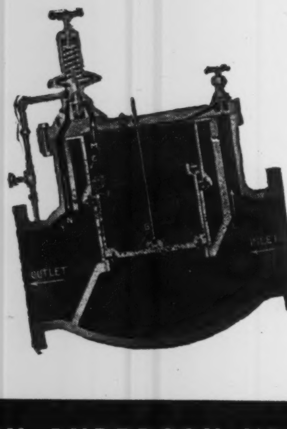

Headquarters:
a center of authority

. . . a definition that correctly describes GOLDEN-ANDERSON'S service and ability to supply the valve or valves you need! Count on us as a source that knows and understands your problems. Write for our latest catalog . . . see for yourself the broad extent of the GOLDEN-ANDERSON line of Specialty Valves. Shown here are two of the more than forty types of G-A Specialty Valves. Top, the Altitude Control Valve, featuring a Differential control permitting its use on any depth tank. This valve may be arranged for remote control—is available in single or double acting styles, in 2" to 36" sizes. Below, the Water Pressure Reducing and Check Valve—insures continuous terminal delivery service, features smooth adjustment, no metal-to-metal contacts. It is supplied in ½" to 36" sizes.

GOLDEN-ANDERSON VALVE SPECIALTY CO.
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Men and Jobs

Harold Conkling, who recently resigned as deputy state engineer of California, department of water rights, has established offices as consulting engineer in Los Angeles. He specializes in water supply problems, groundwater hydrology, appraisals and valuations, and economic studies.

Capt. George F. Nicholson, CEC USNR, has been appointed public works officer as well as officer in charge of construction at Hunters Point Navy Yard, San Francisco, Calif.

A. R. Hannaford has been appointed building commissioner for Hamilton, Ont. He has been on the city engineer's staff since 1921, prior to that on railway work with the Grand Trunk. Recently, he has been office and designing engineer under W. L. McFaul, city engineer.

James E. Rohr has been appointed state highway superintendent in Wayne County, Ohio. He succeeds W. P. Critchfield, who retired after serving six years. Mr. Rohr has been in engineering work in Wayne county for more than 20 years.

J. L. Dickson, former engineer of road design for the Texas Highway Department at Austin, has become engineer-manager of a San Antonio urban expressway project. He will be responsible to the state engineer for design and construction of a San Antonio urban project announced earlier by the commission. He was district engineer for the state highway department from 1933 to 1937 and since has been engineer of road design. He will conduct all surveys and investigations for the selection of location and design of the facility. His successor is **Thomas C. Collier,** former assistant district engineer, with the department over 18 years.

William C. Pabst is district maintenance superintendent at Everett, Wash., for the state highway department. He succeeds **Harvey Wallace,** transferred to the district state highway engineer's office at Seattle as location engineer. M. Pabst formerly was in construction work at Everett.

Frank A. McComber, city engineer, of Duluth, Minn., since 1943, has resigned. He will return to the position with the city water, gas and sewage disposal department, which he held before his appointment as city engineer.

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